THE

Mineralogical Magazine

AND

JOURNAL

OF THE

MINERALOGICAL SOCIETY

OF

GREAT BRITAIN AND IRELAND.

VOLUME III.

Reprinted 1965 for
Wm. DAWSON & SONS LTD., LONDON
with the permission of
THE MINERALOGICAL SOCIETY

ORIGINALLY PRINTED IN GREAT BRITAIN BY MESSRS. LAKE AND LAKE, TRURO. REPRINTED OFFSET LITHO BY BIDDLES LTD., THE CITY PRESS, GUILDFORD, SURREY

1127-13

Vol. III.—No. 13.] [JULY, 1879.

THE MINERALOGICAL MAGAZINE

AND

JOURNAL

OF THE

Mineralogical Society

OF

GREAT BRITAIN & IRELAND

INSTITUTED 3rd FEBRUARY, 1876.

EDITED BY THE HON. SECRETARY.

Reprinted 1965 for
Wm. DAWSON & SONS LTD., LONDON
with the permission of
THE MINERALOGICAL SOCIETY

Mineralogical Society of Great Britain & Ireland.

—o—

OFFICERS FOR 1878—9.

PRESIDENT.

H. C. SORBY, F.R.S., &c., &c

VICE-PRESIDENT.

THE REV. PROFESSOR HAUGHTON, F.R.S. &c., &c.
PROFESSOR M. FORSTER HEDDLE, M.D., &c., &c.

COUNCIL.

PROFESSOR A. H. CHURCH, M.A., &c.
FRED. DREW, F.G.S., &c.
MAJOR DUNCAN, M.A., D.C.L., &c.
ARCHIBALD GEIKIE, F.R.S., &c.
THOMAS DAVIES, F.G.S., &c.
TOWNSHEND M. HALL, F.G.S., &c.
M. HAWKINS JOHNSON, F.G.S., &c.
DR. ROBERT OXLAND, F.C.S., &c.
PROFESSOR T. G. BONNEY, M.A., &c.
DR. WALTER FLIGHT, F.C.S., &c.
PROFESSOR A. H. GREEN, F.G.S.
W. H. HUDLESTON, M. A., &c.

TRUSTEES.

THE RIGHT HON. LORD DE BLAQUIERE, F.R.G.S.
PATRICK DUDGEON, F.R.S.E.

TREASURER.

R. P. GREG, F.G.S. &c.

GENERAL SECRETARY.

J. H. COLLINS, F.G.S. &c.

FOREIGN SECRETARY.

C. LE NEVE FOSTER, B.A., D.Sc., &c.

LOCAL SECRETARIES.

Cornwall—B KITTO, F.G.S.
Lancashire—T. A. READWIN, F.G.S., &c.

AUDITORS FOR 1878—9.

B. KITTO, F.G.S.
F. W. RUDLER, F.G.S., &c.

The Mineralogical Society exchanges its publications with the following Societies, Public Bodies, and Editors:

Royal Society of New South Wales, *Sydney*.
Reale Comitato Geologico d'Italia, *Rome*.
Department of Mines, Nova Scotia, *New Brunswick*.
Societé Géologique de Belgique, *Liege*.
Leeds Naturalists' Club, *Sheffield*.
Yorkshire Naturalists' Union.
Academy of Sciences, *Philadelphia*.
Società Toscana de Scienze Naturali, *Pisa*.
American Journal of Science, *Newhaven*.
Zeitschrift für Kryst. und Min., *Strasburg*.

Exchanges of a kindred character are invited from other Societies and Editors.

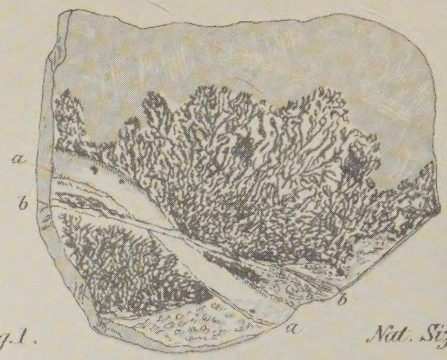


Fig. 1. *Nat. Size.*

Moss-form Gold in Quartz. a a and b b Secondary Quartz Veins.

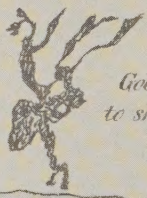


Fig. 2. *Gold Thread magnified, to show shaky character.*

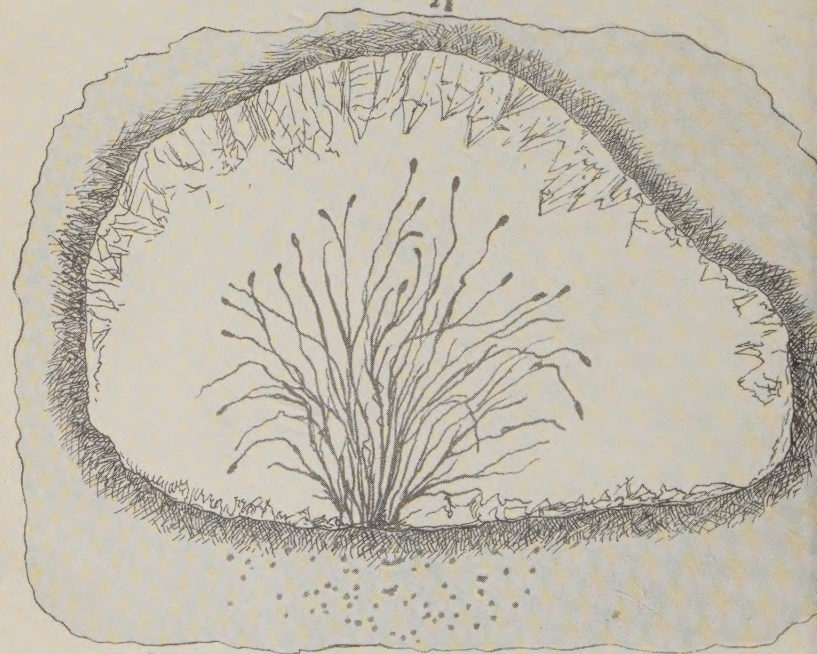


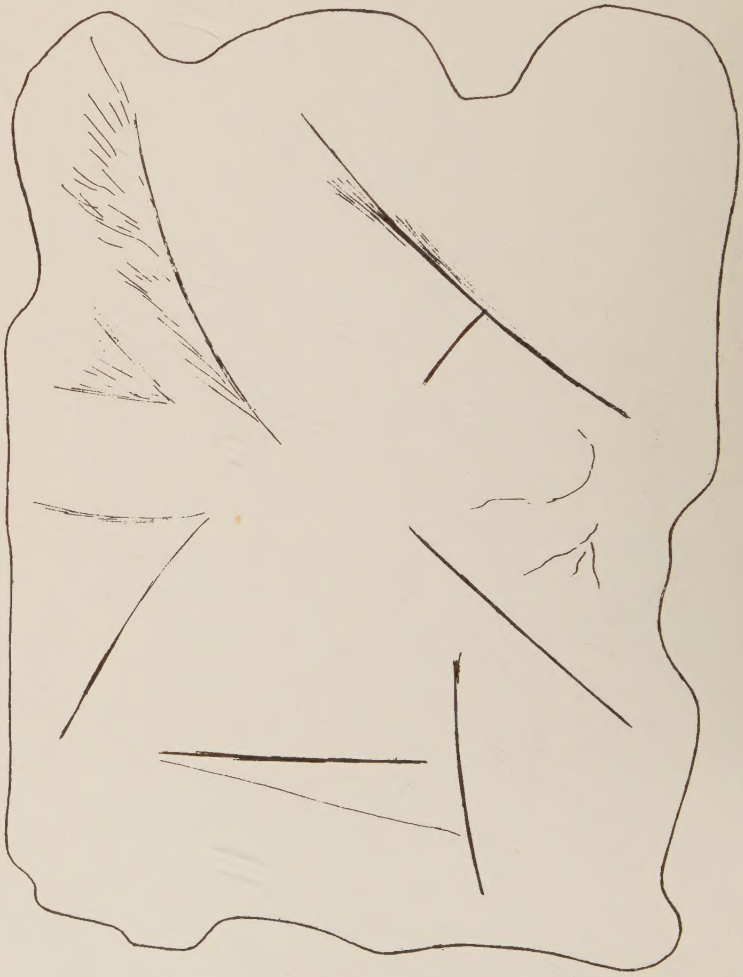
Fig. 3. Golden tree in quartz cavern about ½ nat. size.

Copied from original partly coloured plates.

Digitized by the Internet Archive
in 2023

https://archive.org/details/mineralogical-magazine_1879-07_3_13

The "Maxwell-Stuart" Topaz.



Natural Size.

The "Maxwell-Stuart" Topaz.

Fig. 1 Front view. Natural size.
Weight 1475·9 Grains. or 368 Carats $3\frac{2}{10}$ Grains
Colour Pure White.
Specific Gravity, 3·5685.
Locality, Ceylon.
Fig. 2. Side view. Natural size.
now in the possession of Mr. Bryce-Wright.

PROCEEDINGS.

OF THE

MINERALOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND.

1879.

EXCERPT MINUTES OF COUNCIL MEETING

Held at 116, *Victoria Street, London, June 3rd,* 1879.

Professor T. G. Bonney, M.A., in the Chair.

The voting papers having been examined, it was

Resolved—That the following gentlemen be elected to complete the list of Corresponding Members,—

Prof. Brush, Newhaven.
Prof. B. Von Cotta, Freiberg.
Prof. Daubree, Paris.
Prof. Descloizeaux, Paris.
Prof. Delesse, Paris.
Prof. Geinitz, Dresden.
Prof. F. von Kobell, Munich.
Prof. Rammelsberg, Berlin.
Prof. G. vom Rath, Bonn.
Prof. Renard, Brussels.
Prof. Rosenbusch, Berlin.
Prof. F. Sandberger, Wurzburg.
Prof. Tschermak, Vienna.
Prof. F. Zirkel, Leipzig.

The following ordinary members and associates were also declared duly elected.

ORDINARY MEMBERS.

Capt. Dowler, 60, Maddox Street, London, W.
Mr. S. Francis Bawden. Rio Tinto Mines, Spain.
Rev. J. E. Somerville, Broughty Ferry.
Mr. Colin B. Phillips, St. Andrews.
Mr. Samuel Henson, Strand, London.
Mr. J. P. Howley, St. John's, Newfoundland.

ASSOCIATES.

Mr. Geo. F. Tregelles, Falmouth.
Mr. R. J. Cunnack, Helston.

Resolved—That the Annual Meeting be held at Sheffield, on Friday, August 22nd.

GENERAL MEETING,

Held at 116, *Victoria Street, London, W.*

Professor T. G. Bonney, M.A., in the chair.

The following papers were read and discussed:—

On Abriachanite—a new Scottish mineral, by Prof. Heddle and Dr. W. H. Aitkin.

On Haughtonite—a new Mica, by Prof. Heddle.

On Bhreekite and Xantholite, by Prof. Heddle.

On some Gold Occurrences, by Rev. J. Clifton Ward.

Minerals from Japan, by John Milne.

On Christophite, from St. Agnes, Cornwall, by J. H. Collins.

Additional note on Penwithite, by J. H. Collins.

Measurements of Angles of Basaltic Columns at the Giant's Causeway, by Prof. J. H. Jellett and Prof. O. Reilly.

Specimens in illustration of their papers were exhibited by Prof. Heddle and Mr. J. H. Collins.

Mr. J. R. Gregory exhibited some fine Chalcedonic Geodes enclosing fluid, from Salto Chico, Dagracto Salto, Uruguay.

The Secretary announced that Dr. Heddle's large Geological and Mineralogical Map of the Shetland Islands was in the hands of the mounter, and would be issued to the Members as soon as completed.

Thanks were voted to Mr. R. H. Scott for the use of his office on the occasion of the meeting.

BOOKS RECEIVED TO JULY.

From *Prof. J. D. Dana*, Newhaven. American Journal of Science.—May and June.

,, *Academy of Sciences*, Philadelphia. Proceedings 1878.

,, *Reale Comitato Geologico*, Rome. Bolletino 3 and 4, 1879.

,, *Prof. Groth*, Strasburg. Zeitschrift fur Kryst. und Min. Band III. Heft 4.

,, *Rev. S. Haughton*, Dublin. The Mineralogy of Dublin and Wicklow.

,, *G. H. Kinahan*. Quartzyte (Quartz Schist) and Quartz Rock (Greisen).

,, *J. H. Collins*, Truro. The Trelissick Elvan, by J. H. Collins.

,, ,, ,, The Elvan Courses of Cornwall, by A. K. Barnett.

,, ,, ,, The Elvan Courses of Cornwall, by W. H. Argall.

,, ,, ,, A Deposit of Tin in the Park of Mines, by Dr. C. Le Neve Foster.

,, *Rev. J. C. Ward*, Keswick. The Physical History of the English Lake District, by J. C. Ward.

,, *Prof. Sandberger*. Beiträge zur Kenntniss der am Bauersberge bei Bischofsheim, by Sigmund Singer.

,, *Prof. G. Tschermak*, Vienna. Mineralogische und Petrographische Mittheilungen, Band II, Heft 1 and 2.

,, *Prof. Delesse*, Paris. Notice sur les Titres Scientifiques, de M. Delesse.

,, ,, ,, Le fond des Mers, Etudes lithologiques, by M. Alexis Delaire.

,, ,, ,, Gisement et exploration du Diamant dans la Province Minas Geraes au Brasil, by Ch. Bensser and G. Claraz, abstracted by M. Delesse.

,, ,, ,, Memoire sur la constitution Minéralogique et Chimique des roches des Vosges, by M. Delesse.

,, ,, ,, Sur les gisements de Chaux Phosphatée de l'Estramadure, by M. Delesse.

,, ,, ,, Rapport sur un Mémoire de M. Delesse intitulé "Etude des déformations subies par les terrains de la France." Presented to the Academy of Sciences by Messrs. Elie de Beaumont, Ch. St. Claire Deville, and Daubrée, 1872.

,, ,, ,, Cours d' Agriculture professé par M. Delesse, Ecole Nationale des Mines, 1877-8.

,, ,, ,, Sur le porphyre de Lessines, by M. Delesse.

,, ,, ,, Ueber die Menge des dems Kalkspath von Fontainebleau beigemengten Sandes, by M. Delesse.

,, ,, ,, Lithologie des Meere der Alten Welt, by M. Delesse, translated by Herr Hanchecorne, Berlin.

,, ,, ,, Cartes Géologique et Hydrologique de la Ville de Paris, by M. Delesse.

Books received to July (continued).

,,	*Prof. Delesse*, Paris.	Sur ies Rapports Cristallographiques et Chimiques de l' Augite de l' Hornblende et des Minéraux analogues, par M. C. Rammelsberg; translated by M. Delesse.
	Prof. G. Vom Rath, Bonn.	Ueber das Gold, von Prof. G. von Rath; Sammlung gemeinverständlicher wissenschaftlicher vorträge XIV Serie, Heft 324 and 325.

THE MINERALOGICAL MAGAZINE

AND

JOURNAL

OF THE

MINERALOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND

No. 13. APRIL, 1879. Vol. III.

I.—*Contributions towards a History of British Meteorites.*

By Townshend M. Hall, F.G.S., &c.

As the rare descent of Meteorites or Aërolites affords us the only real tangible evidence we possess respecting the mineral constituents which exist beyond the limits of our own globe, a great degree of interest must always be attached to these stray visitors; and although much has been written on the subject at different times, it has hitherto taken the form either of a bare catalogue of the date and place of occurrence; or of scattered notices dealing only with individual cases. My desire is to collect these various records as far as they relate to each meteoric stone which has been known, or has been said to have fallen in Great Britain, and to endeavour to give as complete an account as possible of every instance; including not only the historical facts, but also notices of mineralogical observations and references to authorities.

In collecting the evidence as to the fall of a meteoric stone, it is highly important to obtain the following particulars:—

1. The exact date and place of the occurrence.
2. The number and weight of the stones.
3. External appearance.
4. Chemical composition and specific gravity.
5. In what Museum or private collection the stone or stones have been deposited.
6. References to any published accounts.

Though an answer to all the above questions would be sufficient for mineralogical purposes, there are many other facts bearing upon the subject

which unfortunately are frequently overlooked in published descriptions. For example, it would be interesting to ascertain to what depth the stone penetrated, and in what soil. Whether hot when found. Whether it descended in a cloudless sky, or during a storm; and if a meteor was seen, to note its direction, and whether it exploded before reaching the earth. The accompanying noise, if any, should also be described.

In no single instance have I been able to obtain satisfactory answers to all these particulars; and in some cases, indeed, only the bare fact seems to have been recorded that a stone fell on such a date, and at such a place. Of the stones themselves some have been irrecoverably lost, others have found their way into foreign museums, and some are in the possession of private individuals.

In dealing with long periods of time, and a large area of country, anyone who has attempted to collect evidence regarding an event which took place even a few years ago, must be aware how exceedingly difficult is the task of separating truth from error. My purpose, as I have said before, is to collect everything that is known on the subject of British Meteorites; to establish by means of copious references every fact relative to each recorded fall; and to inquire into all doubtful instances, so as to ascertain, if possible, whether their authenticity can be proved, and to expunge them from the list if they can be shewn to be the results of errors.

The doubtful instances of meteoric falls may be classed under four general heads :—

1st. A meteor has been seen apparently to fall, and a search has been made where it seemed to descend. The results of these searches have included nodules of pyrite, fragments of scoriæ, hematite, and ordinary pebbles, all distinctly terrestial, but which have been described as "Meteorites."

2nd. A mistake for ball lightning; the popular opinion being that a thunderbolt is a red hot stone, capable of setting fire to houses or barns, instead of a simple discharge of electric fluid. For this reason any instance of a meteorite alleged to have fallen during a thunderstorm, should perhaps be looked upon with an extra amount of suspicion.

3rd. The historical and typographical errors, common to all writers and printers.

4th. Hoaxes. These, I regret to say, have been perpetrated on two or three occasions recently, and the knowledge of the extreme importance and interest attached to the descent of a meteorite has prompted some unscrupulous persons to send to the newspapers accounts carefully compiled, and bearing every mark of authenticity, which on enquiry have been proved to be without a vestige of foundation.

The authorities I have had occasion to consult in the preparation of the following list have necessarily been numerous; though in the case of well established stonefalls, in which there appears no discrepancy in the various references, I have thought it necessary to insert only one or two of the most important. The catalogues of Chladni and the many continental writers have already been collated and incorporated by Mr. R. P. Greg, F.G.S., in his very extensive catalogue of meteors and fireballs, from A.D. 2 to 1860, published in the Report of the British Association for 1860.* A supplementary list containing numerous additions and corrections of errors, appeared in the Report for 1867, under the title of a catalogue of Luminous Meteors and Aërolites.† Those who have had occasion to consult these two catalogues will, I am sure, unite in bearing testimony to the great care and accuracy with which they have been compiled, and when we remember that they include observations ranging through nearly nineteen centuries, and collected from every part of the world, the laborious nature of Mr. Greg's work must be apparent. Almost all the British meteorites will be found recorded in one or other of these two catalogues; though the adoption of a tabular arrangement necessary prevented the insertion of more details than a statement of the date of the event and place of occurrence, with the size and direction of the meteor when known. The column for remarks distinguishes the entries as meteors, stone-falls, iron-falls, bolides, fire-balls, &c.

A list of 20 British meteoric stones was published in 1858, in Greg and Lettsom's "Manual of the Mineralogy of Great Britain and Ireland."‡ Also a summary by myself in the *Popular Science Review*, 1866, vol. V, pp. 414, 415. Neither of these, however, contained any details beyond a simple record of the date and place of the fall.

To the Reports of the British Association I am further indebted for many notes and references included in the "Annual Observations on Luminous Meteors," commenced by the Rev. Professor Baden Powell, in 1848, and continued since his death in 1860 by a committee. In many cases I have been unable to verify, as I should have wished, some of the earlier references contained in such works as Poggendorff; Annales de Chemie, &c., but wherever necessity has obliged me to quote them second-hand, I have appended my authority for so doing.

In each of the several instances comprised in the following pages, the meteoric stone has been described in some published account to have been actually found; and the first question will be, whether this fact can be clearly proved in every case by sufficient evidence. I have omitted all

* Op. cit. pp. 48 to 118.

† id. pp. 414 to 430.

‡ Art. Iron." p. 246.

mention of the very large number of meteors recorded in the lists of the British Association, as having been seen apparently within a short distance of the earth, and which have been known to burst over some part of Great Britain. Though there can be but little doubt that from many of these stones must have fallen, they have not been found; and, considering what thinly inhabited districts may be met with between the Land's End and Johnny Groat's house, their non-discovery cannot be a matter of surprise. Those which belonged to the class of the aërosiderites or iron meteorites may perhaps be dug up by chance at some future period, and their identity recognized; but those included under the ordinary designation of meteoric stones, and whose chemical composition consists chiefly of silicates, unfortunately bear too great a resemblance to terrestial products to admit of their origin being even suspected by those who may find them.

In closing these prefatory remarks, I should add that the following notes must not be regarded in any way as a complete synopsis, but I hope they will be the means of eliciting from some kind helpers many a fact and many a reference which has escaped my notice, and which I shall be most thankful to receive and incorporate in a supplement, together with any corrections. It would also materially increase the value of the list to ascertain the present location of each stone, and to state in what Museums specimens may be seen.

ENGLAND.

1360.—*Yorkshire.*—

"Stonefall." The earliest recorded British meteorite is thus briefly noticed in Rep. Brit. Assoc., 1860, p. 52. It would be interesting to obtain a few particulars and references to authorities.

1622.—January 10.—*Cornwall.*

"Stonefall, at Tregony. N.B.—not Devonshire." Rep. Brit. Assoc., 1860, p. 53. This entry will be noticed in a subsequent page, under the date 1723.

1623.—January 10.—*Stretchleigh, near Ermington, Devon.*

The fall of this meteorite is described by several of the old county Historians. Risdon, who was engaged between the years 1605 and 1630 in collecting materials for his Chorographical Survey of Devon, gives the following account:—Stretchleigh.—"In this siginory, A.D. 1623, there fell from above a stone of twenty-three pounds weight, which in falling, made a fearful noise, first like the rumbling of a piece of ordnance, which, in descending lower, lessened, and ended, when upon the ground, no louder than the report of a petronel. It was composed of matter like a stone singed or half burnt for lime*"

* Op. cit., p. 186.

Westcote, writing about the same period, related the occurrence in almost the same words. "In some part of this manor (Strechley) there fell from above, 1625*—I cannot say from heaven—a stone of twenty-three pounds weight, with a great and fearful noise in falling, first it was heard like unto thunder, or rather to be thought the report of some great ordnance, cannon, or culverin; and as it descended so did the noise lessen, at last, when it came to the earth, to the height of the report of a peternel, or pistol. It was for matter like unto a stone singed, or half burnt for lime; but being larger described by a richer wit, I will forbear to enlarge on it."†

The "richer wit" here alluded to was, in all probability, the author of a pamphlet published at the time, which further describes this aërolite as having fallen on January 10th, 1623, in an orchard, near some men who were planting trees. It was buried in the ground three feet deep, and its dimensions were three feet and a half in length, two feet and a half in breadth, and one foot and a half in thickness. The pamphlet states that pieces broken from off it were in the possession of many of the neighbouring gentry. Lysons‡ adds that this pamphlet (which I have unfortunately never been able to obtain) also describes three suns seen at Tregony, in Cornwall, in 1622, and this circumstance is important, as throwing some light upon two doubtful entries referred to under the dates 1622 and 1723. In 1869 I called especial attention to the Ermington meteorite in the Transactions of the Devonshire Association§ in the hope of obtaining some clue as to the subsequent history of any of these portions, but so far, my enquiries have been unsuccessful. From the description it is highly improbable that it could have been an iron meteorite, and from comparing the weight with the size it would appear that either the latter must have been very much exaggerated by the writer of the pamphlet, or that Risdon and Westcote must have been mistaken in the weight.

1628.—April 9.—*Hatford, &c., Berkshire.*‖

This fall took place about 5 or 6 o'clock in the afternoon, and by a comparison of various accounts, seems to have spread over a large area. Mr. T. W. Webb¶ directs attention to a letter preserved in Wallington's *Historical Notices*, i, 13, which was written in 1628, by Mr. John

* A probable misprint for 1623.

† A view of Devonshire in 1630, by Thomas Westcote, gent., Oliver's Ed. Exeter, 845, pp. 391, 392.

‡ Lysons' Magna Britannia. vol. vi, pt. 2; Devon, pp. 175, 176.

§ Op. cit., vol. III, pp. 75, 78.

‖ Erroneously described in Greg and Lettsom's Mineralogy, p. 246, as August 9 Hatfield.

¶ Nature, July 14, 1870.

Hoskins, dwelling at Wantage, to his son-in-law Mr. Dawson, a gunsmith, dwelling in the Minories without Aldgate, relating to the fall of these meteorites. Describing the explosion, Hoskins says:—"It began as followeth: First, as it were, one piece of ordnance went off alone. Then, after that, a little distance, two more, and then they went as thick as ever I heard a volley of shot in all my life; and after that, as it were the sound of a drum . . . . . .Yet this was not all; but as it is reported, there fell divers stones, but two is certain in our knowledge. The one fell at Chalows, half-a-mile off (from Wantage), and the other at Barking five miles off. Your mother was at the place where one of them fell knee-deep, till it came to the very rock, and when it came at the hard rock it broke, and being weighed, all the pieces together, they weighed six and twenty pound. The other that was taken up at the other place weighed half a tod, 14 pound."*

The weight of the stone which fell at Hatford was 24 lbs. according to the entry in the Rep. Brit. Assoc., 1860, p. 54. These three points Hatford, Challow, and Barking (Balking or Baulking?) give some idea of the size of the space over which the meteoric fragments were dispersed. As measured on the map, it forms a triangle, Balking and Hatford being the base, about three miles in length; and each point being distant from Challow about four miles.

1642.—August 4.—*Near Woodbridge, Suffolk.*

This stone fell at 4.30 in the afternoon, and weighed 4 lbs. Noticed in Gentleman's Magazine, 1796, p. 1007; Rep. Brit. Assoc., 1860, p. 54.

1680.—May 18.—*London.*

Several meteoric stones are said to have fallen on this occasion; some being near Gresham College—Rep. Brit. Assoc., 1860, p. 55. The fall is noticed by Chladni, Annales de Chimie, 1826, p. 257 (Phipson).

1723.—*Cornwall, England.*

"Stonefall (not in 1622 as in Cat. No. 1)" Rep. Brit. Assoc., 1867, p. 414. This entry has caused me much perplexity, and I believe it to be only the result of an involved series of mistakes. The original entry in the first catalogue, of which this is a correction, gives as already mentioned under date 1622, January 10. "Cornwall, England.—Stonefall at Tregony. N.B.—Not Devonshire." It is a curious circumstance that in the corrected entry the year only is given, the month and day being omitted. Also that the next succeeding entry relating to a meteorite at Halstead, Essex, in 1731, is dated Jan. 10, instead of March 12, which according to all other authorities was the true date of this descent.

* W. Flight, Geol. Mag., Ser. 2, Vol. II. p. 266.

I cannot but think, in spite of the fact that Ermington in Devon and Tregony in Cornwall are some 42 miles apart, the whole of the entries refer to the same event. The Ermington or rather Strechley meteorite, so well established by the evidence of several contemporaneous writers, is omitted in both the Brit. Assoc. Catalogues, and the date Jan. 10, 1623, has been altered by Chladni, and in Greg and Lettsom's Mineralogy, to Jan. 10, 1622. This, however, is easily explained, as at that time the civil year terminated on March 25th, and an occurrence taking place in January would be indifferently entered as belonging either to 1622 or 1623.

If the entry in the second catalogue be correct, the coincidence of two stone-falls in adjoining counties, with the exact interval of one hundred years between them would be a very remarkable one; but I believe the most probable explanation is, that the meteor which fell at Strechley, on Jan. 10, 1622 or 3, came in a westerly direction at a somewhat low angle, and was seen to pass over Tregony, though by some slight error in the date, the two occurrences, which in fact were separated from each other only by distance, have also become separated by a greater or less interval of time.

1725.—July 3.—*Mixbury, Oxfordshire.*

Stonefall; weight 20 lbs. Rep. Brit. Assoc., 1860, p. 56. Greg and Lettsom's Manual of the Mineralogy of Great Britain and Ireland places the occurrence under the same date, at Mixburg, Northamptonshire: but this is clearly a mistake.

1731.—March 12.—*Halstead, Essex.*

"Stonefall and fireball." Rep. Brit. Assoc., 1860, p. 56. In the supplementary catalogue the entry stands thus:—"1731, Jan. 10, Halstead, Essex; detonating meteor; Stonefall doubtful, Cat. No. 1." As stated in the preceding page, I am inclined to think that the date Jan. 10 has been printed in error, and belongs to another event.

1780.—April 1.—*Beeston, Northamptonshire.*

Stonefall at 9 p.m., April 11? Ironfall? Rep. Brit. Assoc., 1860, p. 60.

1795.—December 13.—*Wold Cottage, Thwing, East Riding of Yorkshire.*

This celebrated meteorite fell on a Sunday, at 3 o'clock in the afternoon, in the grounds of Major Topham. It penetrated into nineteen inches of soil and hard chalk, and weighed 56 lbs. The stone was transferred by Major Topham to Mr. Sowerby, and was subsequently purchased by the British Museum for £250.* According to the official catalogue the present weight is 47 lbs. 9 ozs. 53 grains.† The Imperial cabinet at

* Sowerby's Mineralogy, p. 222.

† The latest catalogue gives the weight as 45 lbs. 8 ozs.

Vienna also possesses a small specimen. The specific gravity as given in Rep. Brit. Assoc., 1860, p. 61, is 3·70. In 1796 the stone was exhibited in London, and in the same year an account of the fall was published in the Gentleman's Magazine. The chemical composition was investigated by Luke Howard, and compared with that of Meteorites from Portugal, Sienna, and Benares. The results were published in the Philosophical Transactions for 1802, under the title of "Experiments and Observations on certain Stony Substances, which at different times, are said to have fallen on the Earth." According to Phipson* this paper is remarkable as containing the first chemical analysis of an aërolite that was ever made.

1803.—July 4.—*East Norton, near Leicester.*

"Stonefall? meteor and detonation; struck a building; electrical?" Rep. Brit. Assoc., 1860, p. 62. A note refers to an account in the Encylopædia Britannica. It is described as being more like an electric ball, and yet a vitrified stone was found, containing nickeliferous iron. This should, perhaps, be included amongst the doubtful instances.

1806.—May 17.—*Basingstoke, Hampshire.*

"Stonefall after a detonating meteor," weight 2½ lbs. Rep. Brit. Assoc., 1860, p. 63.

1813.—August or September.—*Malpas, Cheshire.*

Dr. T. Thomson, in his *Annals of Philosophy* for November, 1813,† states that he received some weeks previously a letter from Chester, dated the 15th of September, containing the following information, which the writer says was first communicated to the public in a provincial newspaper. He does not give the date; but merely quotes the following passage from the newspaper, in the words of the anonymous writer of that article.—"Last week having occasion to go to Malpas (a village 15 miles from Chester), I witnessed a very singular phenomenon. About one o'clock in the day, from the great heat and calmness of the air, I apprehended a thunder storm, and supposed my apprehensions were going to be realized, when I beheld a bright cloud, out of which fell some large stones, which were soft and intensely hot at first, but afterwards acquired considerable hardness." Dr. Thomson adds:—"I am not aware that any of the stones in question have been brought to London. These phenomena have been of rare occurrence in Great Britain of late; but five or six examples of similar falls on the continent, during the years 1811 and 1812 have been recorded, and the stones subjected to chemical analysis."

1816.—August or July.—*Glastonbury, Somerset.*

"Stonefall." Rep. Brit. Assoc., 1860, p. 65.

* Meteors, aerolites, and falling stars, p. 5.

† Vol. II, pp. 396, 397.

1825 ?—May 12.—*Bayden, Wiltshire.**

"Ironfall" (Poggendorff, VIII, 1826.) "According to P. A. Kesselmeyer, of Frankfort, the piece of iron which fell is in possession of Mr. Schwickard, in Mexico, who bought it from a mineral dealer in London. Prof. Nöggerath, of Bonn, is said to have seen it; it looked like meteoric iron, and the magnetic needle was greatly affected by it. Possibly the same as the large meteor seen in Gloucestershire, May 12, 1826," and which according to Baumhauer was aërolitic, and visible in Wiltshire. Rep. Brit. Assoc., 1860, p. 71.

1827 or 1828 ?—August or September.—*Allport, Derbyshire.*

At 3 p.m. a meteoric light traversed the sky, followed by an explosion. "The meteorite picked up, supposed to have fallen on this occasion, now in Dr. R. A. Smith's possession, of Manchester, appears to Mr. Greg to be a more than doubtful substance; more like a kind of compact charcoal, with particles of sulphur and iron pyrites imbedded; nevertheless peculiar; pieces are stated to have fallen after the explosion occurred." Specific gravity 2·0. Rep. Brit. Assoc., 1860, p. 72.

1830.—February 15.—*Launton, near Bicester, Oxfordshire.*

A stone weighing 2½ lbs. fell at 7 p.m. with noise and light. Specific gravity 3·625. Rep. Brit. Assoc., 1860, p. 72, According to the same authority, it was in the possession of Dr. Lee, F.R.A.S. See Buck's Gazette, April 10, 1830.†

1835.—August 4.—*Aldsworth, near Cirencester, Gloucestershire.*

This meteorite fell at 4.15 p.m., and originally weighed 2 lbs. Specific gravity 3·4. The weight of the portion in the British Museum is given in the catalogue as 11b. 2ozs. 128g. According to Rep. Brit. Assoc., 1860, p. 75, a great concussion high up in the air was heard at the same time in South Herefordshire, and probably resulted from the bursting of this meteor.

1842 ?—August 5.—*Harrowgate, Yorkshire.*

5 p.m., Stonefall (Kämtz). "A hot stone like basalt, accompanied by whistling in the air, and lightning and thunder, said to have fallen; resembling a stone that fell some years before at Cardiff, further particulars of which latter not obtainable at present (see Poggendorff, Supp. IV, 1854, p. 366; also, l'Institut, No. 457.) The Harrowgate stone is described also as containing silver-white metallic looking particles. N.B.—A very doubtful fall." Rep. Brit. Assoc., 1860, p. 80.

* Baydon, near Hungerford ?

† I believe this meteorite was in the Oxford University Museum, in 1863, but my note with reference to it is unfortunately mislaid.

1876.—April 20.—*Rowton, Wellington, Shropshire.*

With the exception of the somewhat doubtful iron meteorite already noticed in 1825, at Baydon, Wilts, this is probably the only recorded instance of the fall of an aërosiderite in the British Isles. An account published in the *Times* of April 26, 1876, gives as the exact locality, a turf field near the Wellington and Market Drayton Railway, about a mile north of the Gradgington Station. It is stated that about ten minutes to 4 on Thursday afternoon, within a seven mile's radius of the Wrekin, the villages were alarmed by an unusual rumbling noise in the atmosphere, followed immediately by an explosion, resembling the discharge of heavy artillery. Rain was falling heavily throughout the afternoon, but there was neither lightning or thunder. About an hour after the report, a Mr. G. Brooks went into a meadow in the occupation of his stepfather, Mr. Bailey, and noticed that a hole had been cut in the ground. He probed it and found that what was apparently a hard stone had buried itself in the ground to a depth of 18 inches, passing through four inches of soil and 14 of clay. It rested on the gravel beneath these, and was quite hot, although nearly an hour had elapsed from the time of the explosion being heard. The stone was dug up and removed to Wolverhampton, where it was found to be a mass of meteoric iron. The hole was almost perpendicular, and the meteorite is assumed to have fallen in a south-easterly direction.

The meteorite was in the possession of Mr. Gibbons of Wolverhampton, and was first exhibited at a Bazaar in aid of St. Peter's Church, and afterwards at a Meeting of the Birmingham Natural History Society. Subsequently, with the consent of the Duke of Cleveland, in whose property it fell, it was presented to the British Museum. The Report of the British Association Committee on 'Luminous Meteors' (1876, p. 166), gives some additional particulars from a communication by Professor Maskelyne* It is described as weighing 7¾ lbs.† and being a mass of "metallic iron irregularly angular, although all its edges appear to have been rounded by fusion in its transit through the air, and, except at the point where it first struck the ground, it is covered by a thin black pellicle of the magnetic oxide of iron. The surface is somewhat pitted or marked with slight depressions, one of which occurring in a fissure of the mass, affords some instructive evidence of the causes of their formation. The exposed metallic part of the surface exhibits crystalline structure very clearly when it is etched..... It is only the seventh aërosiderite or meteoric iron of which the fall has been witnessed, although upwards of a hundred iron

* "Nature," July 27, 1876, vol. XIV, p. 472.

† The exact weight of the specimen in the British Museum, as given in the last catalogue, is 7 lbs. 11 ozs.

masses have been discovered in different parts of the globe, which are undoubtedly meteoric, and two such have been found in Great Britain.*"

ISLE OF MAN.

1813 to 1819.—*Pulrose.*

"Stonefall; light and scoriaceous." Rep. Brit. Assoc., 1860, p. 67.

SCOTLAND.

1676.—*Orkneys.*

"Stonefall; fell into a boat." Rep. Brit. Assoc., 1860, p. 55.

1802 ?—September 15.—*Loch Tay.*

"Stonefall; doubtful." See Monthly Magazine, October, 1802, p. 290. Rep. Brit. Assoc., 1860, p. 62. In Greg and Lettsom's Mineralogy a meteorite is stated to have fallen in Scotland, in October, 1802. This probably refers to the same occurrence: the date of publication being mistaken for that of the actual fall.

1804.—April 5.—*High Possil, Glasgow.*

According to Phipson† this stone fell with a loud hissing noise, preceded by explosions. The Rep. Brit. Assoc., 1860, p. 62, adds that it took place in the day time, and gives the specific gravity of the stone as 3·53, a portion weighing 3 oz. 95 grains is in the British Museum, and another in the Imperial Cabinet at Vienna.

1830.—May 17.—*Perth.*

Catalogue British Museum; the weight of the specimen is under 1 oz.

Of meteoric iron not seen to fall, two instances have been discovered in Scotland, the first is described by Greg and Lettsom‡ as being "a small angular and rounded mass, with a closely crystalline texture, is extremely hard, and where cut and polished, shows numerous small triangular figures, more brilliant than the rest of the surface, as in most meteoric irons. It was found a good many years back by Da Costa at Leadhills, and is now in Mr. Greg's collection.' A small fragment under 1 oz. in weight is in the British Museum, the catalogue of which fixes the date of discovery between the years 1820 and 1830.

The other example was found at Newstead in Roxburgshire, and is dated 1861 in the same catalogue, the weight being 18 lbs. 1 oz ||

---

* Leadhills, and Newstead in Scotland.

† Meteors, Aërolites, and Falling Stars, p. 40.

‡ Manual of the Mineralogy of Great Britain and Ireland, 1858, p. 245.

|| The latest Catalogue gives the date 1827.

IRELAND.

1771 ?—Locality ?

Stones said to have fallen. Rep. Brit. Assoc., 1860, p. 59. A stone like a grey siliceous pebble. Annales de Chemie, vol. lxxxv, p. 278, 1813. Possibly same as 1779 at Pettiswood.

1779.—*Pettiswood, County Westmeath.*

Weight 5 oz. Gentleman's Magazine, Sept. 1796. Rep. Brit. Assoc. 1860, p. 60.

1810.—August.—*Mooresfort, County Tipperary.*

According to the entry in Rep. Brit. Assoc., 1860, p. 64, this meteorite fell at 11.30 a.m. on August 10. Specific gravity, 3·67. Two portions are preserved in the Museum of the Royal Dublin Society, and are thus described in the catalogue :—"Meteorolithe of an ash-grey colour, coarse grains, with imbedded particles of malleable iron, iron pyrites, minute globules of a soft greyish-brown substance, and grey mica. It fell near Mooresfort, County Tipperary, in the month of August, 1810. It weighed seven pounds and three quarters, and was of a somewhat cubical shape."

Five specimens in the British Museum weigh 12 ozs., one of which was described in an old catalogue as containing quartz globules of a greenish colour, owing to oxide of nickel. The Imperial Cabinet of minerals at Vienna also possesses two specimens.

1813.—September 10.—*Adare, &c., County Limerick.*

This is a very important stonefall, as it consisted like that in Berkshire in 1628, of many distinct portions spread over a large area. In the Rep. Brit. Assoc., 1860, p. 65., the weights of three are stated at 15 lbs., 6½ lbs., and 24 lbs., with a specific gravity of 3·64. According to the same authority the fall took place at 9 o'clock in the morning.

The following localities are given :—

Limerick, neighbourhood of (Cat. Roy. Dub. Soc.)
Patrick's Well, Limerick (Cat. Mus. Trin. Coll. Dub.)
Adare (Cat. Trin. Coll. Dublin : Brit. Mus., Vienna, &c.)
Faha (Cat. Brit. Mus.)
Scagh (Rep. Brit. Assoc., 1860, p. 65.)
Brasky (Phillips's Mineralogy by Brooke and Miller.)

The mineralogical description of three specimens in the Museum, Trinity College, Dublin, is thus given in the catalogue. (1) "Exterior coating of a dark brown colour, and exhibiting the appearance of semi-fusion. Fracture surface granular, gray, and presenting a few metallic points of a light colour and metallic lustre. Adare.—(2) "Ash-gray

colour, and coarse granular fracture, with some yellowish-brown spots and numerous imbedded particles of meteoric iron; external crust brown and glazed. Limerick.—(3) Fracture surface of a granular structure and gray colour, with yellowish spots and numerous shining imbedded particles of meteoric iron. Patrick's Well."

The Royal Dublin Society's collection possesses two "meteorolithes of a bluish-grey colour; with metallic grains, partly covered with a brownish-black glazed crust, which fell with others in the neighbourhood of Limerick." These no doubt belong to the same descent. The Imperial Cabinet at Vienna has three specimens from Adare. The British Museum specimen weighs 3 ozs. 105 grains.

The chemical constituents of this meteorite, originally investigated by Professor J. Apjohn* has recently been examined by R. Apjohn,† who finds that it contains a trace of Vanadium; but the date which he assigns to the fall of this stone (1810) appears to be that of another Irish meteorite which fell at Mooresfort, Tipperary. The nickel-iron has the composition:—Iron, 85·120; Nickel, 14·275; Cobalt, 0·602; Phosphorus, trace=99·997; and the result of the treatment with acid:—

	SiO_2	Al_2O_3	FeO	MnO	CaO	MgO	Na_2O	K_2O	P_2O_5	
Soluble	42·91	2·35	16·93	6·26	5·34	24·32	0·29	0.02	--	=98·42
Insoluble	59·48	3·24	7·94	8·84	4·62	13·17	1·86	0·30	trace	=99·45

The mineralogical composition of the stone is stated to be—

Nickel-iron	19·07
Chromite	1·75
Magnetic-pyrites	6·54
Soluble Silicate	35·44
Insoluble Silicate	37·07
	99·87

1844.—April 29.—*Killeter, near Castle Derg, County Tyrone.*

This fall is entered in the Rep. Brit. Assoc., 1860, p. 82, as occurring at 3·30 p.m., and is thus described:—"specific gravity 3·76. Stonefall. No meteor; many small ones; musical sounds in the air." I have obtained no further information than this. A specimen in the British Museum weighs under 1 oz.

1860?—June 8 or 9.—*Raphoe, County Donegal.*

Stonefall at 2 p.m., during a storm of thunder and hail. Rep. Brit. Assoc., 1860, p. 107, refers to the *Londonderry Sentinel* of June 15, 1860: "It does not appear there was any fire-ball; the stone resembled friable

* J. Apjohn, Trans. Royal Irish Acad., xviii, 17.

† R. Apjohn, Journ., Chem. Soc., Ser.. 2, vol. XII, p. 104 (see Rep. Brit. Assoc, 187 p. 246, and Geol. Mag. Ser. 2, vol. II, p. 367).

sandstone; it was seen to fall near Raphoe, and was about as large as a duck's egg. It had neither outside crust, nor shining metallic particles; was quite cold and moist when picked up. The fragments of this stone have been mislaid or lost, unfortunately."

1865.—August 12.—*Dundrum, County Tipperary.*

Meteor not seen. At 7 p.m., a report like a cannon-shot and buzzing noise was heard, and the stone fell into the ground, where it lay, half-buried in the earth, milk-warm; weight 4 lbs. 14 ozs.; specific gravity 3·07 to 3·57 in different parts of the stone, which has the form of a three-sided pyramid; the base freshly broken; the faces vitrified and separated from each other by sharp edges of the crust, as distinctly as if ruled with a ruler. Of the earthy portion of the meteorite, that which is soluble in muriatic acid is nearly pure olivine; the insoluble portion is a highly siliceous mineral.

The proportions are:—

Nickel-iron (Chladnite) ..	20·60 (Fe 19·57; Ni 1·03)
Protosulphuret of Iron (Troilite)	4·05
Chrome Iron-ore	1·50
Mineral soluble in Muriatic Acid	33·08 (FeO 5·89; MgO 14·81)
Mineral insoluble in do.	40·77
	100·00*

A fragment in the British Museum weighs under 1 oz.

APPENDIX.

DOUBTFUL OR FICTITIOUS STONE-FALLS.

1594.—*Leominster, Herefordshire.*

Among the municipal records of the town of Ludlow is preserved a vellum roll, with a list of Bailiffs in the time of Queen Elizabeth. Under the above date occurs the following entry:—

"A greate barne in Lempster fired by a commett, and burned 15 dayes." (Rep. Brit. Assoc., 1865, p. 128.)

1640.—Whit-Sunday.—*Antony, near Plymouth.*

A tract by the Rev. Arthur Bache bears the following title:—"The Voyce of the Lord in the Temple; or a most strange and wonderfull Relation of God's great Power, Providence, and Mercy, in sending very strange sounds, fires, and a Fiery Ball into the Church of Anthony neere Plimmouth, in Cornwall, on Whit-Sunday last 1640. To the scorching

* Rep. Brit. Assoc., 1866, p. 131. (From Scientific Papers Royal Irish Academy Proc., vol. I. p. 230.)

and astonishment of fourteen severall persons who were smitten, and likelikewise to the great Terrour of all the other people then present, being about 200." (Bibliotheca Cornubiensis.)

1668 (about).—*Wethersfield, Essex.*

In a letter dated 14th Feb., 1868, the late Rev. R. Kirwan, F.S.A., informed me "that in the old registers of the Parish of Wethersfield there is a notice in Latin of two meteorites that appeared about 200 years ago."

1791—October 20.—*Menabilly, near Fowey, Cornwall.*

Included in the list of Meteoric Stones by Chladni, and in Greg and Lettsom's Mineralogy. The Rep. Brit. Assoc., 1860, describes it as a fall of hail-stones.

1844 or 1845.—*Lymington, Hampshire.*

A supposed aërolite said to have fallen.

1846.—August 10.—*County Down, Ireland.*

"An iron said to have fallen and been picked up, but either the whole story is a hoax, or the iron itself purely artificial." (Rep. Brit. Assoc., 1860, pp. 84, 85.)

1852.—December 17.—*Dover, Kent.*

A meteor probably aërolitic, appeared to fall partly in the sea, about half a mile from land, and partly on the beach. The stones said to have been found after the explosion, proved to be nodular concretions of pyrite, identical in all respects with those so common in the neighbouring cliffs. (See also Phipson's Meteors, pp. 54, 55).

1858.—May 4.—*Aylesbury, Buckinghamshire.*

An ignited globe, exploding with noise, set fire to a straw-yard. "Hit a cow; smell of sulphur; no stone found; probably electrical." Rep. Brit. Assoc., 1860, p. 95.

1858.—June 12.—*Birmingham.*

See subsequent notice, 1868, May 29.

1860.—July 29.—*Little Bridy, Dorsetshire.*

"? A dark substance fell with noise and light on reaching ground." Rep. Brit. Assoc., 1867, p. 418.

1861.—August 1.—*Chorley, near Lancaster.*

A letter in the *Times* with the above date and address, gave a most circumstantial account of the fall of an aërolite 83½ lbs. in weight. It was described as an irregular ellipse, the major axis being $11\frac{3}{4}$ inches; the minor axis $7\frac{5}{8}$ inches. It fell into a road, and buried itself nearly 6 feet in the ground. I made several inquiries at the time, but failed in ascertaining that there was any truth in the narrative.

1868.—May 29.—*Birmingham.*

The *Birmingham Daily Post* for May 30, 1868, contains a letter signed Thomas L. Plant, F.M.S., describing a violent thunderstorm on the previous morning. The concluding paragraph of the letter is as follows :—"There was an extraordinary phenomenon during the deluge of rain. From nine to ten, meteoric stones fell in immense quantities in various parts of the town. The size of these stones varied from about $\frac{1}{8}$th of an inch to $\frac{3}{8}$ths of an inch in length, and about half those dimensions in thickness. They resembled in shape broken pieces of Rowley ragstone. A similar phenomenon visited Birmingham ten years ago. On the 12th of June, 1858, during a severe thunderstorm, there fell a great quantity of meteoric stones, in every respect like those discharged this morning."

As another alleged meteoric storm took place in the same neighbourhood, and at an interval of less than a year, it may be interesting to compare the two accounts.

1869.—May 25.—*Wolverhampton.*

The following extract from the *Birmingham Gazette* appeared as a reprint in Symons's Monthly Meteorological Magazine *—"At the conclusion of the thunderstorm at Wolverhampton, on Tuesday evening, several persons noticed a large number of small dark stones lying upon the streets and roads, the drive of the London and North Western Railway Station, Queen Street, Queen Square, and Waterloo Road being especially strewed with them. From the peculiar character of the stones, bearing resemblance to nothing with which the roads are paved, or any stones found in the district, it was concluded even by the uninitiated, that they were meteoric stones, and must have fallen during the heaviest and most alarming period of the storm. A considerable number was gathered that night, and more the next morning. Our correspondent has some in his possession, and has shewn them to several gentlemen, one of whom saw the last shower of meteoric stones that fell at Birmingham in June last, and stated that those that have fallen at Wolverhampton were precisely of the same character. They appear, however, to have been a little larger ....those at Birmingham being from $\frac{1}{8}$th to $\frac{3}{8}$ths of an inch,....while some of those picked up in Wolverhampton were $\frac{3}{4}$ of an inch in length, and $\frac{5}{8}$ths of an inch in thickness. Like the stones in Birmingham, too, they have something like the appearance of Rowley rag, but on breaking them up the difference of character is at once apparent. A chemist in the town found that, by judging from mere surface examination, they resembled iron pyrites. The matter is exciting a very general attention,

* Op. cit., vol. IV, pp. 137, 138.

and there are a great many searchers gathering up the remains of this strange shower from the heavens."

Immediately on seeing in the newspapers the account of the supposed fall at Birmingham, I made numerous inquiries by letter, and endeavoured, but without success, to obtain a single fragment of the stone said to have fallen in such quantities. An editorial note appended to the extract in the Meteorological Magazine invited further particulars regarding the Wolverhampton shower, but was only met by a letter containing a general denial of the truth of the statements. Taking the whole of the evidence, I think it must be conceded that in both cases fragments of stone did actually fall during the thunderstorms; but the meteoric origin of the fragments by no means follows as a matter of course. Instances of dust and small stones being taken up from the ground, and carried along for a considerable distance by a storm, are not unknown, if uncommon, and in the absence of any analysis or other reliable data, it may be suggested that the showers at Birmingham and Wolverhampton were due to this cause.

1869.—November 6.—*Fawley, near Southampton.*

The *Standard* described two meteors seen about 7 p m., and a "meteorite" weighing more than 1 lb., which was discovered four days later. "It had not penetrated the ground more than half an inch." From the account it would appear to have been a nodule of iron pyrites, washed out of the soil by heavy rain. (See W. Flight, Geol. Mag., Ser. 2, vol. II, p. 26.

1874.—August 1.—*Hexham, Northumberland.*

In the *English Mechanic* for Aug. 21st, a letter signed "Ralph Lowdon," of Gateshead, describes a massive ball of intense light accompanied by other pear-shaped balls of fire, seen to drop towards the earth.

The aërolite which is alleged to have fallen in an orchard on the bank of the North Tyne, at no great distance from Hexham is stated to have been found the following day at 9 a.m., at a depth of 14 inches in the soil, still quite warm, and to have weighed 301½ lbs. Enquiries made by Dr. W. Flight, F.G.S., resulted in the return of his letters by the Post-Office authorities, and a reply from the Rector of Hexham that he cannot find even the slighest foundation for the statements.*

* Rep. Brit. Assoc., 1875, p. 240; and Geol. Mag., Ser. 2, vol. ii, p. 263.

II.—*The Geognosy and Mineralogy of Scotland.*—By Professor Heddle.

MAINLAND, Part II.

HILLSWICK NESS.

THIS is a mere fragment of gneissic rocks which is imbedded between the granite of Roeness and the igneous rock which lies to the east: but so different are these entrapped rocks from the ordinary gneiss of Shetland, and so violent a twist do they seem to have received athwart of their normal strike, that the enquiry rises—whence did this fragment come?

A spectator looking west from the top of Ornsfield, gazes seaward upon a mere heap of ruins; while, looking landward, he also sees little else,—so riven and twisted are the rocks by the intrusion of dykes of porphyry, and so shattered and toppling from the invasion of the sea.

The strata lying to the north of this rising ground may be included under the name of hornblendic gneiss, though in many places they more resemble diorite; those lying southward of a line drawn south-eastward from this spot, are chiefly of the nature of chlorite slate.

Every variety of such rocks and endless intermediates, however, occur; they are so convoluted and crushed into one another that dips of all angles, and strikes which appear to radiate from a plurality of centres are not unfrequent.

However distracting to the geologist, such a land of promise to the mineralogist and lithologist is but rarely to be seen.

Despite of the rock turmoil within, or perchance as a result thereof, the ground is so uniformly covered with a firm and close sward, that it is only on the coast line that exploitation can be carried out; and so break-neck is much of the shore that the following record cannot but be incomplete.

At the *Ting of Turness*, *hornstone* of a brownish-red colour occurs (Hb), it is somewhat earthy, and occasionally porphyritic, the imbedded crystals being bright-red twinned orthoclase. There is here much "claystone porphyry."

At *Staba*, on the north, and at an equal distance from the mouth of the *Nidister* to the south, *hornblende* occurs imbedded in white *albite*

(D. & H.) The former is here of two very different appearances,—in the first, plumes or divergent brushes, a couple of inches in length, of lustrous dark-green crystals, lie bedded in snow-white cleavable masses of albite; in the second, flat, equally lustrous, foliated crystals are impacted singly in the same matrix. Both are striking varieties.

The latter of these spots affords specimens in which pink or flesh coloured *albite* is in foliated crystals, imbedded in the white variety. The specific gravity of this pink variety is 2·615. Its unusual colour induced me to analyse it.

It yielded—

Silica	66·711
Alumina	19·813
Ferrous Oxide	·9
Magnesia	·093
Lime	1·382
Potash	1·264
Soda	9·229
Water	·542
	99·934 (H.)

This albite was minutely striated.

The compound of albite and hornblende is in such quantity as to constitute a rock.

The diorite of Fetlar contains hornblende and *anorthite;* that of Colafirth and Nidister, hornblende and *albite.*

The low rocks and shore south of the mouth of the Nidister ("*the Banks of Nithista*") afford several varieties of *hornblende*, and in large quantities (Hb.); a variety in jet black highly lustrous minute scales, and another in large interlacing crystals of considerable lustre and a dark green colour, are perhaps the finest.

This hornblende sometimes contains cavities filled up by radiating crystals of *epidote* (D. & H.) of the thickness of knitting needles, and an inch or more in length. This epidote was dull, soft looking, and of an olive green colour; its only associates were a fiery-red granular felspar, and a bright red substance which occurred in thin investing layers, and which (or something very similar to which) I have also seen in granite in Rubislaw, as well as elsewhere, with hornblende.* The specific gravity of this epidote was 3·396.

* I believe this to be an undescribed mineral, but I have never been able to get enough for analysis.

It yielded,

Silica	37·866
Alumina	24·722
Ferric Oxide	9·961
Ferrous Oxide	·361
Manganous Oxide	·536
Lime	23·104
Magnesia	·766
Water	2·822
	100·078 (H.)

Although the inclosing hornblende has no appearance of even incipient decomposition, yet it must be said that the epidote has itself some appearance thereof.

The same spot also yields veins (?) consisting of transverse fibres of leek-green *actynolite*, with occasional plates of brilliant *Biotite*. (D and H.)

A nook, just where these banks become cliffy and curve round to the east, is quite a nest of minerals; these occur in beds which strike inland to the north-west, and eastward are seen in a little rocky stack.

First there occurs or rather occurred "a bed of *actynolite* not less than two feet in width, of a fibrous structure, of a splendid leek-green or pistachio-green colour, and of a silky lustre." (Hb.) Hibbert hardly does justice to the beauty of this bed, the few remaining bits of which the writer bore away. The mineral was in parallel crystals half an inch in width, these were separated from each other by films of a soapy *chlorite* (?); the crystals are well-formed six-sided prisms, but are not terminated; they are semi-transparent and green. Their specific gravity is 2·993.

They yielded,

Silica	55·
Alumina	1·512
Ferric Oxide	·994
Ferrous Oxide	3·456
Manganous Oxide	·307
Lime	10·381
Magnesia	23·307
Potash	1·12
Soda	1·097
Water	2·898
	100·072 (H.)

There immediately follows on the south of this wrought out bed of glassy actynolite, a bed of *precious serpentine* of the finest character. (D.

and H.) It is in two layers—one is a rich green to sulphur yellow, the other a rich umber brown. Both are highly translucent; they are very brittle, cut with a knife like slate pencil, but still are softer than the nail. They are very uniform and pure.

The specific gravity of the green is 2·522.

It yielded,

Silica	41·46
Alumina	·01
Ferric Oxide	2·422
Ferrous Oxide	1·163
Manganous Oxide	·23
Lime	trace.
Magnesia	41·763
Water	12·43
	99·478 (H.)

In contact with this serpentine there is found a bed about two feet thick of *anthophyllite* (H.) The outside layers of this bed consist of flat short crystals of the mineral; its inner portion is an interlacing mass of crystals, which are about two inches in length. These lie in all directions, are of a clove-brown colour, and of a vitreous lustre. From the manner in which the crystals are relatively disposed, as well as from their own nature, they form a mass of the most extreme toughness.* Minute specks, which appear to be *molybdenite*, are to be seen among the crystals. (H.)

The specific gravity of this anthophyllite is 3·068; the cleavage angle of the crystals 125° 23′.

They yielded.

Silica	56·861
Alumina	4·495
Ferrous Oxide	8·131
Manganous Oxide	·871
Lime	1·087
Magnesia	25·874
Water	3·355
	100·624 (H.)

* A lump, less than a cubic foot in size, could not be broken by a 28 lb. hammer, and after repeated blows had failed in producing the smallest sign of fracture, it was found that the steel, of 1½ inch in thickness, was rent across the whole face. The baffled quarry man happily characterised the mass as a "bundle of petrified nails."

Two veins or beds were observed in the shingle running seaward from this corner; on sufficient exposure, they were found to consist the one of *Biotite*, the other of *talc-chlorite* of Traversella. (D. and H.)

The Biotite was a mass of soft, friable, scaly crystals, hardly cohering its colour was brown, it had little lustre, and was soapy to the touch. Its specific gravity was

It yielded,

Silica	39·803
Alumina	14·185
Ferric Oxide	2·594
Ferrous Oxide	11·784
Manganous Oxide	·24
Lime	·097
Magnesia	18·32
Potash	8·43
Soda	2·11
Fluorine	·56
Water	2·52
	100·643 (H.)

The substance which formed the second vein, which was of much larger dimensions, was examined partly on account of a peculiarity in its appearance and partly from its appearing to Professor Roscoe to be very similar to the foliated green vanadiate which had been named after himself. It occcured in such quantity that it could be raised in spadefuls: It was quite pulpy, had a higher and more pearly lustre than chlorite or clinochlores, and in certain positions reflected a light of a golden hue. Its colour was that of a somewhat pale chlorite. As it fell asunder into loose scales in water, its specific gravity could not be ascertained.

It yielded,

	Dry.	Wet.
Silica	39·81	35·461
Alumina	11·432	10·183
Ferrous Oxide	7·974	7·103
Manganous Oxide	·259	·23
Lime	2·804	2·498
Magnesia	25·648	22·846
Potash	1·203	1·072
Soda	3·152	2·808
Water	7·913	17·994
	100·195	100·195 (H.)

It lost at 212° 10·945 of its water. This large content of water a ordinary temperatures was not observed by Marignac, who probably dried the mineral in the bath without previous weighing.

If we except the presence of alkalies in the Shetland mineral, its composition agrees with that from Traversella, and aids in entitling it to be considered a distinct mineral.

Dana conjectures that talc-chlorite may be merely "ripidolite impure from mixture with talc;" but the Shetland mineral in no way bears out such a view. In order to free it thoroughly from saline impregnation it was suspended in water, many times changed, and scales of one size taken for analysis. During the suspension it was carefully examined with a magnifier, and there was no appearance of the smallest admixture of scales of talc.

The small outstanding rock at this corner of the shore contains a small remaining portion of the vein of actynolite; as the finely tinted green crystals are here imbedded in lustrous white scaly *talc* (D and H.), the appearance of the specimens is striking.

Under the impression that this talc was Damourite it was analysed and yielded,

Silica	60·889
Alumina	4·143
Ferrous Oxide	1·24
Magnesia	28·085
Potash and Soda	traces.
Water	4·72
	99·077 (H.)

Its specific gravity was 2·825.

Specimens of actynolite rock here also contain plates of fine lustrous *Biotite*, and equally brilliant ones of *chlorite* (D. and H.)

The pinkish-red variety of *steatite* called "Klebber" is also found here (Hb.) Hibbert adds potstone, but he seems to have confused this, here at least, with precious serpentine.

The great amount of contortion which is to be seen about *Stack Sound* gives countenance to the hope that it might afford minerals; the rocks all around seemed inaccessible, except by landing from a boat. Dr. Gordon succeeded in procuring for me excellent typical specimens of the rock. Careful examination of these leaves no doubt in my mind that the rock is essentially the same as the zoned diorite already described as occurring at Colafirth; the only difference visible to the lens which I could perceive was the presence in the lighter-coloured layers of a considerable amount of quartz. This quartz imparts an unusual endurance to the albitic layers, which stand out in high relief, where the hornblende has been rotted out by the sea spray.

The observation by Dr. Gordon of rocks very similar to those of Colafirth and Hillswick at the head of Roeness Voe, goes far to connect all these rocks with each other.

No finer illustrations of metamorphic rocks of an intermediate type could be pointed out than these schistose diorites of Colafirth and Hillswick. At Colafirth the metamorphism sometimes goes a step further, and the schistose character almost disappears. But here it is not so. The rock on the large scale is like a plicated gneiss; hand specimens show its components and arrangement of parts to be that of diorite, while in a mass of but a few inches in dimensions we have a condensed delineation of the structure of some 60 yards of the gneiss of Sutherland.

Under the microscope this rock shows the arrangement of the hornblendic ingredient to be somewhat peculiar; this, in form like grains of corn, is arranged in a somewhat plicated manner, their long diagonals being nearly parallel with the layers of albite; a red substance, doubtless garnet, is also present.

The first spot south of Cliff Sound where the cliffs can be safely descended is *Quin Geo*; this, being divided by a projecting point, must be scaled at two places.

In the *North Quin Geo* violet *fluor* occurs in octahedral crystals, imbedded in calcite, in a matrix which carries epidote. (D. and H.)

Epidote occurs here filling a small vein; it is in rich green crystals of over an inch in length, disposed in a stellate manner over the face of the rock. (D. and H.) The specimens are fine.

Its analysis yielded,

Silica	36·127
Alumina	20·574
Ferric Oxide	14·921
Manganous Oxide	·306
Lime	23·025
Magnesia	·306
Water	4·568
	99·827 (H.)

Rose quartz occurs here forming a smooth-sided vein (D and H.) The structure is here different from that which it assumes elsewhere in Scotland; being very massive, calcedonic, and almost hyaline; it appears to have been originally formed of a granular congeries of crystals little larger than shot, which have been so semifused into each other as almost to obliterate their lines of contact, and to be obscurely saccharoid. The cleavage is thus not rectilinearily continuous, and the mass is diaphanous but not transparent. The colour is pale but fine.

In *South Quin Geo* several veins of a *purplish-pink quartz** occurs (D. and H.); the structure of these is massive fine granular; this quartz is sheathed by foliæ of a mixture of margarodite and chlorite; veins of quartz in a splendent mica slate here carry imbedded dodecahedra of brownish-red *garnet* (Hb.) which imparts a peculiar glandular-like structure to the quartz.

The bight immediately to the south of Quin Geo was named *Carneba* to the author, but as Hibbert mentions a number of minerals as occurring here, none of which were found by the author, while they were all found by him at the spot called Sandy Geo, which is not mentioned by Hibbert at all, there may be some doubt as to the correctness of the name.† At the *Carneba* of the map there were only found some *purple quartz*, and thin veins of a blue-black colour. These, on hasty inspection, appeared to be Lydian stone, on a closer, to be a matted mass of crystals of the variety of tourmaline termed *scorza*; while other portions appear to be a laminated mixture of hyaline quartz with some black mineral unknown. The veins also carry a very red compact felspar in imbedded crystals, with small quantities of radiating epidote identical with that seen in Quin Geo (D. and H.)

Almost at the most southerly point, at a spot called *Baalan*, a vein of crystals of actynolite, identical in appearance with that described as having occurred at Nidister, may be seen on the very brow, and cutting down the face of a beetling cliff. (H.)

Hibbert's statement regarding Carneba is "at a place named Carnebie, is much steatite approaching to the character of potstone, yet of a softer consistence, and of a brownish-purple red colour. Common chlorite is in junction with it, of an earthy foliated character, the colour of which is a brilliant dark green. Interspersed in this mass are numerous small octahedral crystals of magnetic iron ore, of a bluish-black colour."

Descending *Sandy Geo* with the aid of a rope, there are to be found all these substances stated to occur at Carneba. The massive granular *steatite* is of a peculiar reddish-yellow colour; the massive granular *chlorite* is in such intimate association with it, as to prove a close relationship to subsist between the minerals, or in their mode of formation.

That this is the spot to which Hibbert applies the name of Carnebie is shown by his notice of a most interesting and beautiful association of magnetite with ripidolite. Dispersed somewhat sparingly throughout the pinkish steatite are rosette crystallisations of ripidolite, the crystalline plates being disposed around a centre, like an opened out and completely

* Hibbert mentions "much of the substance of a very red compact felspar;" it is possible this compact quartz may have been mistaken for the above.

† Dr. Gordon has ascertained that my naming is correct.

circular fan, and the centre of each of these rosettes is a perfectly formed and brilliant octahedral crystal of blue-black magnetite. As the plates of ripidolite are of perfect transparency and a brilliant dioptase colour; the specimens, though small, are of very considerable beauty.

This, being one of the purest looking ripidolites in Scotland, was analysed, and gave,

Silica	32·549
Alumina	13·95
Ferric Oxide	·972
Ferrous Oxide	5·275
Manganous Oxide	·156
Lime	·79
Magnesia	32·785
Potash	·48
Soda	·062
Water	13·173
	100·192 (H.)

There is here, as also at the adjoining geo, the same chronicling of names cut into the steatite as has been noticed as occurring at Fethaland. The Shetlanders call such places "The Klebber-names."

The cliffs are now intersected by porphyry, and inaccessible until the point denominated *Vanlup* is reached. Here the strata becomes more of the nature of mica schist, or of a mica schist in which the components are segregating apart.

In the quartzose belts of this rock very fine specimens of *kyanite* (Hb.) are found. These are of two varieties; in the one, belts of massive reddish quartz carry isolated bundles of diverging crystals of the mineral, which are very characteristically and beautifully disposed like plumes of feathers—the colour is here red, shading off into bluish or greenish white. In the other variety, masses of interlacing bundles of crystals unite to form large nodules, which lie bedded directly in the micaceous layers of the schists. These bundles are separated from one another at some points by bunches of crystals of *chlorite* and *margarodite*. The kyanite here is pale blue, or red passing into white, sometimes somewhat chocolate coloured.

The latter variety yielded,

Silica	38·153
Alumina	56·979
Ferric Oxide	1·867
Manganous Oxide	·153
Lime	·301
Water	2·646
	100·099 (H.)

The matrix of kyanite at the foreign localities being Damourite, the glistening silvery-lustred plates associated with this kyanite, were analysed, under the impression that they too were that mineral. Their extreme softness during the picking them out, led to their being considered talc; the analysis shewed them to be *Margarodite* (D. and H.)

They yielded,

Silica	45·43
Alumina	29·65
Ferric Oxide	8·33
Manganous Oxide	·02
Lime	·79
Magnesia	1·7
Potash	6·94
Soda	2·27
Water	5·29
	100·42 (H.)

The specific gravity was 2·825.

In Greg and Lettsom's Manual of Mineralogy, under the head of Babingtonite there occurs the sentence—"In this country it has only been found in one of the Shetlands; it occurs in large irregular laminated crystals of a blackish-green colour imbedded in white quartz." This sentence is copied in somewhat briefer terms into many works; and, from the statement being somewhat more full in Allan's Mineralogy and in the above than in these, as well as from the single specimen upon which the statement was founded having been in the old Allan collection, the probability is that it was found by Dr. Hibbert, and presented to Mr. Allan.

The present writer has in vain attempted to find Babingtonite in Shetland; the toil that he has endured in "walking down" distant veins of white quartz has not been little, the white quartz of the islands has itself suffered considerably in consequence, and he has frequently fervently desired that the writer of the above sentence had, from the top of Rona's Hill, viewed the thousand-and-one inlets of these marvellously tortuous shores, and so learned the necessity of writing with precision and point, in indicating localities.

The question as to what the something was, which in Allan's collection had received the name of Babingtonite, possibly may be correctly answered by saying that it was one of two things—either the large laminated crystals of hornblende of a blackish-green colour which occur imbedded in white labradorite in Balta, or large laminated crystals of *chlorïtoid* of a blackish-green colour, which the present writer found imbedded in white quartz at Vanlup.

The possibility that it was the first of these rests upon the fact tha shortly after the Allan-Greg collection became the property of the Natior the said specimen was found not to be Babingtonite, and was set aside a an ill-defined or inferior specimen of hornblende*; I have already show that Hibbert mistook white albite for quartz at Colafirth, and he was quit as likely to mistake the labradorite of Balta for quartz.

The possibility that it was the chloritoid of Vanlup lies in the resemblanc which that mineral bears to the dark-green laminated form which Babing tonite sometimes assumes, and to its being imbedded in white quartz.

Be this as it may, seeing that Professor Maskelyne discovered that th Allan specimen was not Babingtonite, and that the writer failed durin several prolonged visits to Shetland to find that rare mineral when specia sought for, the pen must be drawn through the record of its Shetland o currence; and, however much we may regret its temporary† exclusi from the list of British minerals, there is no little satisfaction in the kno ledge that we are drawing the pen at this same time through a senten which should never have found a place in the literature of an exa science.

The *chloritoid* presents two appearances (H.); the first, which attra ted attention from its colour, is thus described:—Occurs in quartz vei in the immediate vicinity of the kyanite and margarodite, and in th near vicinity of garnet, ilmenite, and specular iron. Its colour is clov or chocolate-brown. Lustre shining, slightly pearly. Streak greyish Cleavage basal, perfect but somewhat interrupted; parallel to tw lateral planes, imperfect and rough. Structure foliated. In roug lozenge-shaped crystals apparently monoclinic. Hardness 5·5 on th cleavage plane; 6· on the lateral. Brittle. Specific gravity 3·356.

It yielded,

Silica	25·363
Alumina	41·736
Ferric Oxide	3·895
Ferrous Oxide	13·932
Manganous Oxide	·919
Lime	·901
Magnesia	6·82
Water	6·571
	100·137 (H.)

* Professor Maskelyne, who kindly had a search made for this discarded specimen tells me that, doubtless on account of its having been considered a worthless specimen c a well-known mineral, it has not been preserved.

† It is merely temporary. I have less regret in expunging the Shetland record, seein that I have found Babingtonite in two localities in Scotland The first, which I hav analysed, is in a granitic mass near Tongue in Sutherland. The second, which shows single well-defined crystal, is in diorite from the neighbourhood of Portsoy.

An examination of the second variety shewed that the first was partially altered. Except in colour and lustre the description is the same. The colour of the perfectly fresh mineral is blackish-green to dark green; its lustre is more pearly; its streak was pale-greenish grey.

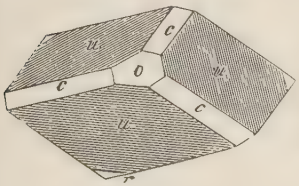
Its gravity ranged from 3·313 to 3·462.

On analysis it yieded.

Silica	24·47
Alumina	41·336
Ferric Oxide	·383
Ferrous Oxide	18·522
Manganous Oxide	·913
Lime	·302
Magnesia	6·80
Water	6·98
	99·706 (H.)

Both varieties invariably occur in imbedded rough crystals, and the green variety contains imbedded *sphene.*

The laminæ of all the rocks in this locality are highly contorted, the convolutions being shewn by extreme plications of the layers which are composed of a mixture of plates of margarodite and chlorite, with minute flakes of specular iron. Among these plates there occur the following minerals;—the two first, being interlaminated therewith obey the plications of their matrix. *Specular Iron* in thin plates, and rarely in crystals of the above (*o u c r*) form. (H.)



SANDY GEO.

The faces *u* are striated by an oscillation with *r*, or an intermediate face.

Ilmenite (H.) in blue-black plates, some inches in size, by about one-eighth in thickness. Its specific gravity is 4·916.

It yielded,

Titanic Acid	20·6
Silica	1·4
Alumina	1·443
Ferric Oxide	63·549
Ferrous Oxide	11·26
Manganous Oxide	·018
Lime	1·792
	100·062 (H).

Rutile (H.) a single brilliant crystal non-terminated, but showing the prismatic faces M h l. *Limonite* pseudo after pyrite, in cubic crystals (H.) *Apatite* (H.) a single hexagonal crystal half-an-inch in width, of a beryl-yellow colour. Fine masses of high-lustred dark-green *chlorite* also occur (H.)

The quartz veins carry in their interior large plumose masses of pale-green *talc* (D and H.); also garnets in *d* crystals (Hb.); their colour is brown, they are much flawed or of a granular structure, and the crystals have rough faces. Granular *chlorite* also occurs in pseudomorphs after the smaller crystals of garnet (H.)

Hibbert writes of this spot—"a little to the north of Vanleep, talcose schist may be found much resembling mica, being of a pearl-grey colour, and remarkably unctuous to the touch. Its plates show a perfect want of elasticity. There is in union with it much *Steatite*. At the same place mica-slate appears of a very splendent lustre, being composed of thin pellicles alternated with plates of very pure white quartz."

The "remarkable unctuosity" and "perfect want of elasticity" indicates that Hibbert regards this as a well-marked sample of the so-called talcose-schist; "pellicles" which answered most completely to his description, and which were both remarkably unctuous and wanted elasticity, were therefore picked for analysis, and yielded,

Silica	45·421
Alumina	30·30
Ferric Oxide	6·874
Manganous Oxide	·816
Lime	·6
Magnesia	2·6
Potash	6·088
Soda	2·01
Fluorine	1·06
Water	5·011
	100·78 (H.)

This is *margarodite*, and thus we are accumulating evidence entitling us to hold—as that variety of muscovite was not recognised in Hibbert's time, while he admits that it much resembles mica,—that all Hibbert's talcose schists are margarodite schists.

The following point of distinction between talc and margarodite is direct,—when rubbed in the fingers, however greasy "pellicles" of margarodite may appear, friction merely reduces them to smaller and

thinner pellicles; while talc, when similarly treated, rubs down to an inpalpable coating, the individual particles of which are not recognisable, from their minuteness.

This *margarodite* forms layers upon laminæ of the quartz, and occasionally hexagonal crystals are imbedded in the latter; the lustre is very high, but they have little or no elasticity.

Grariesum. About the divisional point between Vanlup and this, a few pieces of *Kyanite* were found, portions of which had a brilliant *azurite* blue colour, and these also had in small quantity a thin coating resembling *chrysocolla* (D and H.) *Garnets*, but of no beauty, occur here.

The late ardent mineralogist Mr. Copeland, of Blackwood, informed the writer that he found *green-fluor* on the west side of Sandwood bay.

The circles which indicate mineral localities have, in the map of Hillswick, been placed above the cliffs; this was done to prevent their being mistaken for the small stacks, of which so many environ the shore; the spots where the minerals are found, however, are either near the sea level, or on the slopes which descend thereto.

Eastward of Urie Firth there lies the large mass of the rock which Hibbert has called epidotic greenstone. This rock is of a very fine crystalline structure, usually of a dark-grey colour, but reddish where it approaches the rocks of Hillswick. Examined by the microscope it is seen to consist in largest amount of a felspar which is not distinctly striated,—augite,—and irregularly-shaped masses of a garnet-red mineral; this however, has not the fracture of garnet, but is either striated or fissured in a rectilinear manner, the fissures being equidistant.

This rock carries veins of a granite similar to that which forms the veins in the breccia of Colafirth.

PAPA STOUR.

This island is considered in this place, as it is composed of the same rocks as those described as occurring in the south-west of Northmavine; however, we have in addition felsitic rocks and porphyrys which have burst through the bedded rocks.

The interbedding of porphyritic and amygdaloidal traps with Old Red Sandstone strata is well seen on the south shore of the island: the intrusive rocks are mostly confined to the west and north—they are very circumscribed in dimensions. The general dip of the sandstone is to the west in different directions, but almost always at low angles. Beds of volcanic breccia and conglomerate are not infrequent.

The porphyrys are of the soft "Claystone" variety, of red-brown or reddish-purple colours, with ill-defined crystals of red orthoclase and yellowish-white albite (?) sparsely distributed throughout the base.

The volcanic breccias contain in the more recent paste, portions both of the sandstones (often a conglomerate), and of the porphyrys.

The amygdaloid occurs in largest amount in the south-west at the Kirksands, and in the north between Ollas and Culia Voes; it is of a brownish-purple colour, often very vesicular, but the vesicles are small in size. These various strata of argillaceous and arenaceous sandstones, compact felspars, porphyrys, claystones, and amygdaloids, are intercalated in ever-changing order. The best sections are at Bordie and Ungly-braed Head.

The strata of this island being similar in themselves, similarly circumstanced, and acted upon by the same causes as those in operation at Northmavine, we have a similar or even a greater amount of ruin; here most strikingly exhibited in what might be called the cancellated structure of the island,—caves, arches and vaulted passages arresting the eye as it sweeps round the western shores.

The easily disintegrated rocks have, on the Atlantic side of the island, been cut into cliffs of considerable height. As the not infrequent alterations in the matrix of which the rocks are formed present various powers of resistance to the inroads of the sea, there has resulted the formation of a coast-line of striking features; this is always imposing,—it is only on account of a certain weirdness that it falls short of being magnificent.

Professor Jameson has thus in general terms described it:—"The coasts are rugged and precipitous. Frequently the scenes are truly sublime; vast rocks of varying heights, dreadfully rugged and broken, oppose their rude points to all the fury of a tempestuous ocean; which in some places has formed great detached pillars, in others has excavated grand natural arches and caverns, that mock all human magnificence."

It is this *underground scenery*, indeed, which is of the most unique and surpassingly grand character.

A cave near Houseavoe is thus described by Hibbert:—"I entered in a boat a vault involved in gloom, when, after turning an angle, the water began to glitter as if it contained in it different gems, and suddenly a burst of daylight broke in upon us, through an irregular opening at the top of the cave. This perforation, not more than twenty yards in its greatest dimensions, served to light up the entrance to a dark and vaulted den, through which the ripples of the swelling tide were in their passage converted by echo into low and distinct murmurs."

The west coast from Hamna Voe to Culia Voe is shaped by the sea "into a continual recurrence of excavations."

Of these one is pronounced by no mean judge—Dr. Macculloch—to be *facile princeps* of the caves in Britain. It has been thus described—"when surveyed from the summit of the cliff it appears as a cavity of some hundred feet deep, and about 120 feet in length, being situated at a distance of 180 feet from the sea. It can be explored by means of a boat,—a labour that is only to be accomplished in the calmest weather. A large arch first presents itself, and, after rowing through dark vaults, the light of the sun bursts in from the lofty opening above—here the water is several fathoms in depth. The boat then pursues its gloomy course through another extensive perforation, which at length expands into an immense cavern where the light of the sun is wholly excluded. In the innermost recesses there is a steep beach, where the cave ultimately terminates in a number of ramifying dens."

The north-west point of Fuglöe has, however, been sculptured into a form which, for artistic effect, very much transcends anything which does not possess some measure of exposure to the light of day. Projecting in "pillared state" over the ocean, it has entombed in far-reaching recesses, both sea and air and the light of day. Like a many shafted cathedral-crypt, it stands with pediments set in seething foam. The heavings of the ocean, entangled in a labrinthine gloom, lash against each other in self-destructive effort, expending themselves in

C

sound, which booms from the far-off depths with tympanitic ring, as if the superincumbent mass vibrated to the shock, and each pillar gave back its own metallic note. The swellings of the curling waves, not content with the contrast of their own colours, stream with fleecy foam upon the russet shaftings, exposing in their recoil a verdant mantling—"wrought by the hand which works unseen." The white flash of the sea-bird's wing seems almost to sparkle in the pitchy blackness of this hollow of the land,—whose "far-drawn aisles" present every possible shade in the contrast of light and darkness.

Truly here sea and earth and air, and motion, and colour, and sound seem to have conspired to surfeit all the senses

The exploration of its unknown depths in a boat must be of singularly rare accomplishment:—both tides set right on to it,—it is a place of perpetual motion.

Minerals.

"On the south side of the island and also at Hirdy-geo there are small veins of *hematite*, these are situated in a bed of amygdaloid" (F.)

"At the south end of the Kirksands in an amygdaloidal claystone of a dark-liver colour, druses occur which are filled with *calcareous spar heavy spar, fluor-spar, quartz crystals, chalcedony*, and *green earth*." (Hb.)

The fluor was first noticed by Jameson.

Veins of red *sinople*,—iron flint—associated with chalcedony and *jasper* (J.)

The exact spot is the third igneous rock to the south-west of the Kirksands.

The *fluor* occurs in pale violet, and dark purple cubes.

The paragenetic minerals, arranged in the order of deposition, are —*chalcedony, quartz, calcite, baryte*—lastly *fluor* (D. and H.)

The green earth of Hibbert—"semi-indurated steatite" of Jameson, is *saponite* (D. and H.)

In separate druses *cockscomb baryte* occurs in fair specimens (D. and H.)

Red Heulandite rarely coats the druses in minute crystals (D. and H.)

A single crystal of white *stilbite* was found (D. and H.)

Psilomelane coated with *wad* occurs in the same rock, at the east end of the same mass which carries the fluor (D. and H.) They form two veins.

Saponite (steatite F.) also occurs at Bordie, Ungly-braed Head, and elsewhere in slaty felspar.

The porphyry near Ollas Voe yields druses of *quartz* (Hb.)

Lying loose on the surface Hibbert observed masses of *glassy actynolite.*

From the same anchorage as that from which Papa Stour is examined two localities on the Mainland may be visited.

These are the banks of the hill of Aithsness where Hibbert observed veins of *Chalybite*; and Dale, where he found *compact felspar.*

There is good anchorage in Housa Voe, but the entrance is difficult. The following directions will, in the absence of a pilot, suffice:—divide the entrance into four parts, take the centre of the second from the north. The mark is—keep a white house at the top of the bay just clear to the south of a chapel, seen a quarter of a mile beyond it.

As a safe harbour from whence to visit all the district, none can equal a bight on the north side of Snarra Voe, on the opposite coast of the Mainland.

VEE SKERRIES.

A piece of rock from these skerries which was brought to the writer could not be distinguished from the peculiar mica-gneiss of Vanlup in Hillswick. It was a contorted mass, consisting of much translucent quartz with foliæ of margarodite, chlorite, and a little ilmenite.

SEELIE VOE.

From this fine anchorage the neighbourhood may be examined.

Within a mile to the west there is a large mass of granite, which extends to Gruting Voe, and also forms the east end of Vaila Island. It is of quite a different nature from the granite of the Roe district, being usually highly porphyritic, and consisting of a melange of crystals, in which a yellow felspar is prevalent. The Brough of Cullswick is built of this granite, as is also that of Burra Voe on the West Coast. So that probably a mass of the same granite may occur in that neighbourhood.

The west shore of the Voe consists of so confused an assemblage of granite, hornblende-rock and porphyry, that it probably might yield minerals similar to those of Hillswick.

On the east shore of the Voe thin veins of pale *pinkish quartz* coated with chloritic-schist are sparingly found (D. and H.) The quartz is massive granular in structure, and opaque.

On the south-eastern shore of Kirkaness large veins of what Hibbert calls *rose quartz* occur; the colour, however, is a purplish-pink, of

by no means a delicate tint. The great size of the masses, however, and the somewhat effective manner in which a chloritic gangue is mingled with the quartz, renders these so far striking. We did not, however, find a single fragment which was in the least hyaline.

A very singular cleavage in two directions, yielding an angle somewhat near to that of hornblende, is a marked feature of this *purple quartz*. On the same shore we found granular *chromite* imbedded in green *serpentine* (D. and H.)

A protruding boss of granite, the components of which are unusually large in size, appears about midway between the Kirkaness shore and the south shore of Bigsetter Voe. From this boss large plates of twinned crystals of *Muscovite* are to be got (D. and H.)

Both in the shore at Kirkaness and on the South shore of Bigsetter Voe a porphyry apparently the same as that described as occurring in the north-east of Unst is to be found. There is perhaps a little more epidote, and the crystals of felspar have a redder and finer colour Hibbert calls this rock epidotic syenite. There can be little doubt that it is the same mass as that which has been described as cutting off the Fitfiel Head schist from that of the Cliff hills,—which forms the islets in the Bay of Scalloway,—and which is probably continued in the islands of Yell Sound. It is at Kirkaness a beautiful rock, admirably adapted for monumental purposes, but so far as the writer could judge, has a tendency to separate into brick-shaped masses of small size.

Chromite, bedded in dark-green *serpentine*, has been wrought in the south shore of Bigsetter Voe: associated with it there occur veins of a brilliantly lustrous white felspar, which breaks with large flat cleavages, these being throughout besprinkled with a graphic lettering of hyaline quartz. No portion could be found sufficiently free from the quartz for such an analysis as would do more than qualitatively determine the felspar. There can be little doubt as to its being albite, and the occurrence of a *graphic albite* is probably new (D. and H.)

In the Burn of Tractagill on the opposite side of the Voe, near the junction of the gneiss with mica slate, on the slopes adjacent to Weesdale Hill, an extraordinary quantity of porcelain-earth lies accumulated, owing to the decomposition of the abundant quantity of felspar which the rock contains. "It is of a very yellowish-white colour, and its particles cohere but slightly to each other. The gneiss from which it is produced, appears to be decomposed in such a manner that the position of the strata is not disturbed by the change; for in the disposition of the layers of porcelain earth, I distinctly traced the line of direction and dip assumed by the undecomposed strata of contiguous rocks." (Hb.)

This "porcelain earth" would from the above description appear to be in all respects similar to that of Lumbhoga in Fetlar.

Hibbert makes the following most interesting observations on the gneiss of Selaness in Aith's Voe :—"In this may be observed a vein of felspar 6 feet in width, consisting of rounded spherical concretions, some of which are no less than 6 or 8 inches in length. They are often composed of felspar alone, but sometimes of quartz and felspar. In a few of them mica is very sparingly disseminated. I have described these portions of rocks under the name of concentrically laminar concretions. Each speroid in the vein is formed by concentric layers, inseparable from their nucleus, and these on account of the firm texture of the rock, are not to be traced without careful observation. In some of these concretions I have remarked that each concentric layer was formed by radiating matter, directed from the circumference of the circle towards the centre. The form of the spheroidal concretions is not always very perfect. Their figure is occasionally impaired by the junction, as if they had been pressed against each other whilst in a soft or yielding state; consequently a tuberculous form is sometimes induced."

This very much corresponds with the structure of the speroidal syenite—the Napoleonite of Elba; and I have seen a very similar structure well marked in two other Scotch rocks. The first is in the rock of the island of Ensay in the Sound of Harris. This rock is very much of the nature of the eklogite of Harris; it contains, however, less garnet, and kyanite is not manifest in it. Dr. Joass, of Golspie, sent me specimen from this island consisting of loose and also of imbedded concretions of radiating actynolite, the structure of which, as developed by zones of colour, is similar to that described. They are not, however, of so frequent occurrence in the rock as to impinge upon one another.

The other instance—a most unique and interesting one—is in the possession of Professor Nicol, of Aberdeen. It was found on the south side of Ben-na-chie in Aberdeenshire; the rock is a fine-grained granite, in the midst of which there lies, firmly imbedded in one-half of the specimen, a "concretion," of which the structure is both a radiating and a concentric arrangement of the constituents of the granite. The other half of the specimen shows the "cast" of the separated concretion.

Clay Slate and Old Red Sandstone Localities.

A stratum of limestone curves round from the north west of Rovic Head forming the dangerous rocks called The Brethren, and the islet of Greenholm; in both *Dolomite* occurs in simple crystals in cavities of the limestone (H.)

Sandlodge.

About a mile to the north of this, the clay-slate contains *serpentine* with *steatite* (Hb.) "Among the strata of micaceous schistus which form the cliffs of Coningsburg crystallised *cyanite*" (J.) (kyanite) "of a white colour tinged with azure. Specific gravity 3·618.

The junction of the clay-slate with the unconformable sandstone may be seen a short distance to the west of the house of Sandlodge. Almost at the junction there is an old mine of *specular iron.*

The clay-slate where last seen at its eastern boundary assumes chloritic features, and consequently the overlying sandstone somewhat largely partakes of the same character. Hibbert goes so far as to speak of it in this locality as being a *magnesian sandstone,* adding that it has a steatitic character.

Many small calcareous veins traverse the sandstone near the junction and a little way to the east of Sandlodge, a vein which at the surface seems nearly vertical, but which Dr. Fleming says dips to the east at an angle of 45°, has been intermittently wrought for iron and copper.

This vein occurs in "a reddish-coloured argillaceous sandstone" (F.); it strikes from north-east to south-west: near the surface the ores were chiefly those of iron; those of copper were found at a depth of twenty fathoms chiefly.*

*Professors Jameson, Fleming, Traill, and Dr. Hibbert have alike expressed themselves as having formed great expectations of this vein; Professors Fleming and Traill who minutely inspected the workings, have also alike expressed themselves as having had reason to be utterly dissatisfied with the mode in which it had been on every occasion wrought, and they alike assign the repeated ill-success which has attended the working of this mine to the incapacity and ignorance of the "captain of the mines."

Having examined this mine and its minerals on more than one occasion, having inspected the mode of working during a late attempt, and having had very special opportunities of testing the capacity of the management as regards the two points of following a vein, and recognising mineral species, I have to say that the opinion I have to form agrees with that of the afore-mentioned gentlemen, in at least the two first of the above three particulars. Having also had to come to the conclusion that the Cornish captains of mines who come to Scotland to exercise their function are, with hardly an exception, incapable, and so act a very detrimental part to all judicious mineral-enterprise, I conceive it to be fitting when such an opportunity as the present occurs, to direct attention to the fact in its double bearings.

I shall therefore quote the opinions of Professors Fleming and Traill, and give my own experience.

Professor Traill, who visited the mine in 1803, during the time it was being wrought, writes:—"The miners had penetrated to a depth of about twenty-two fathoms, and were but little incommoded with water. At that time there were but two Cornish miners, besides a Cornish *Captain of the Mines*, engaged, and these were chiefly occupied in giving directions to the natives employed to work in the mine. The want of men sufficiently

Dr. Fleming mentions the following minerals as having been noticed by him:—*Limonite, native copper, fibrous malachite, pyrite, chalcopyrite, siderite, fahlerz.* Dr. Traill added to this list *micaceous iron ore*; he specifies the limonite as occurring in the varieties of mammillated, stalactitic, and fibrous; also columnar bog-iron-ore and brown iron ochre.

The malachite he says occurs, friable and amorphous, "almost equal to the Siberian specimens, and in capillary radiating crystals;" (G. and L.) the latter occurred in such quantity in the twenty fathom level as "to afford a most beautiful spectacle by the light of our candles."

To this list the author has to make the following additions:—among the specimens brought by Dr. Traill from the mine, he recognised *psilomelane*, and also *lepidocrokite* in highly characteristic scaly, fibrous, and glimmering-lustred specimens. At the mine he, with Mr. Dudgeon, found long opaque crystals of *white quartz* crossing each other in a

---

skilled in mining was certainly one cause of their failure. The principal manager was totally ignorant of the art of mining. There was iron in abundance all round. The roads near the mine were all paved with hematites, which the Cornish miners who were there did not seem to regard as of any value, or indeed almost to know. Some of them imagined it was a new kind of copper-ore. Some pieces of bog iron ore which I had collected, were called *copper spume* by one of them; hence it is evident we cannot trust much to the mineralogical opinions of the generality of miners."

Dr. Fleming, who visited the mine in 1808, thus writes:—"The principal vein is said to be nearly fourteen feet broad; none of the shafts have been sunk deeper than fifty fathoms. Brown hematite is found towards the surface in great quantity, and nearly occupies its whole breadth; the sparry ironstone appeared in plenty towards the bottom of the mine, and constituted the veinstone.

The copper-ore was sent to England, where the best of it, it was stated, was sold for £70 per ton. From the month of June, 1802, to the month of June, 1804, four hundred and seventy tons of this iron-ore were sent from this mine to Swansea. Still it is said that the mining company sustained a very considerable loss. Nor ought this to be a matter of surprise. The persons who have been appointed to conduct the work have frequently been men ignorant of the art of working mines, and of the nature and value of the ores which they met with. Many fruitless attempts have been made to find out new veins in the neighbouring rocks, even where no promising appearances presented themselves, whilst the depth and extent of the principal vein appear only to have been superficially examined. The manager or captain of the mine, who was still at Sandlodge, did not seem to be acquainted either with the composition or value of the sparry ironstone or of the hematite, though by far the most common productions of the vein. The difficulty of working the sparry ironstone or veinstones of the copper-ore was stated to me as the reason for abandoning the mine.

Mining operations under such management must generally terminate in confusion and disappointment."

Doubtless!

"Considerably" more than £33,000 expended in two years on a mine, the deepest galleries of which are but twenty-two fathoms, in which they have no water to raise,—sor an adit level carried it all off—and in which a fourteen foot vein is solidly plugged at furface with fine hematites, below with a "veinstone of sparry iron ore!"

How could they have done it?

singular reticulated manner in cavities of ochry limonite. Powdery *wad* which was examined for cobalt, but found to contain no trace;—this was imbedded in cavities lined with crystals of pyrite. *Orthoclase* crystallised with *siderite*, crystallised *chalcopyrite*, and calcite in small *F.* crystals.

Mr. Dudgeon lately noticed in the Edinburgh Industrial Museum minute crystals of a fine green colour, and of a form somewhat similar to that of Brochantite, upon fibres of malachite from Sandlodge.

A minute quantity of these crystals were examined by the writer, and found to contain neither sulphuric, carbonic, nor phosphoric acids, but contained chlorine, copper, and water; they were fusible. The termination of the crystals was that of atacamite, but the position of one of the prismatic planes was new. Probably the mineral is *atacamite*.

Only in the way in which they did do it; by making roads of the fine hematites, and leaving the "veinstone" in sparry heaps at the pit mouth; for, hear Hibbert, writing in 1822:—"Adjoining to the shore is a pavement strewed over with the produce of the veins. Hematites and bog iron ore have made the road as black as Erebus, and caused it to resemble the vicinity of a smelting furnace. The mineralogist *will find some amusement* in examining the ores which lie in heaps near the old shafts; these have been by Mr. Bruce judiciously preserved; they present satisfactory indications of the contents of the vein, and may afford a criterion of the hopes to be entertained from any future prosecution of *the mining operations of Sandlodge*." This peculiar phraseology is perhaps intended to be explained by his going on to tell us of the loss sustained during the drawing the £33,000 in two years.

Dr. Hibbert was not given to jokes.—that above is the only one in his book; geology and mineralogy were to him alike full of seriousness; but surely the staid writer inwardly smiled while making that—to him—unusual "find" among the heaps of ores; and we cannot but speculate as to whether the "find" of a new mineral there would, in all respects, have entailed more gratifiaction.

It was certainly not amusement which the writer experienced when he first saw a great heap of that "sparry veinstone"—hand-dressed during the extraction of the chalcopyrite; but it is fitting that he should express his satisfaction in being able to say that the knowledge of Cornish captains of mines has taken a great stride since the day when the hematites and the sparry veinstone were first rejected. Seventy-four years is perhaps a long time for one stride, but it is a beginning; on the second occasion on which he visited Sandlodge, he found that Mr. Bruce's judiciousness had been incontestably proved; the mines were again being worked, and the heaps of "fine hematites" having been sold, as much thereof as could be grubbed up had been removed.

The average Cornish Captain has therefore now attained to a knowledge of Limonite,—but not of Chalybite—not two strides! Chalybite is still above him; and he seems determined to possess himself of it in no way, for he has *buried it*; the tirring and rock from a new shaft having been thrown over it, leaving merely so much exposed as shows the heap still to be there.

When a freshly-broken characteristic specimen from the said heap was submitted to the person locally in charge of the late workings, it was with confidence, but seeming indifference, pronounced to be "a stuff called felspar."

I wish it to be distinctly understood, that in the above, I allude to such miners only as come to Scotland.

Skewsbrough.

This "Brough," or "Pictish tower," stands on a knoll of *serpentine,* the only bit I was able to find in the district. This serpentine is of a rich green colour, with darker almost black markings, which interlace with one another like the cordage of a net. The colour and appearance are hardly to be distinguished from that of the rock of Towanrieff in Aberdeenshire, and they are perfectly indistinguishable from that of the finer varieties of the stone of the Greenhill of Strathdon.

A little to the east of this brough, veins of *iron-mica* of considerable dimensions, occur in the clay slate, they are associated with a belt, some inches thick, of a green nondescript substance—palpably a mixture, and probably one of the soapy allomorphs of hornblende.

The veins of ironstone may be traced first with an eastern trend, they then curve round the foot of the "Wart" (ward), assuming a northerly direction, and keeping near to the junction of the slate with the Old Red Sandstone grit, until they seem to pass into an old mine of limonite on the west shore of Levenwick.

The iron is throughout associated with quartz; at the south end *kyanite* (H.) and *ilmenite* (H.) rarely occur. Here the iron assumes the features of a bed or beds, but towards the north end it gradually crosses the line of junction of the secondary rocks, and in the Old Red Sandstone is evidently continuous with a vein which appears in the north shore of Hoswick, and which vein in its northern outgoing forms one or other of the Sandlodge veins.

The kyanite is greyish-white to pale blue; the ilmenite is in isolated rough thick crystals; both are imbedded in quartz.

The ilmenite yielded—

Titanic acid	21·11
Silica	1·63
Alumina	·364
Ferric oxide	66·321
Ferrous oxide	8·264
Manganous oxide	1·363
Lime	·211
Magnesia	·374
	99·637 (H.)

Its colour was brownish-black, and its lustre dull.

Black *tourmaline* occurs in crystals of half-an-inch in length in gneiss in the cliffs on the west side of *St. Ninians Island.* (H.)

Sphene is found at *Altaness* in *Burray Island*, in porphyritic gneiss. (F.)—*Ed. Phil. Journ. Vol.* 4, *p.* 214. "*Rutile* occurs in small crystals imbedded in gneiss in Burray." (F.)

A vein of pyrite was worked near the junction of the clay slate with the mica slate at Garthsness near Fitfiel Head, for a doubtful trace of chalcopyrite; and in the clay slate at the Girths of Quendal, north of Fitfiel Head, a large vein of *iron mica* was at one time wrought. Its out-goings in the cliff are quite well seen, but it has been lost further inland: on one occasion when we were there, a "Cornish Captain" was engaged in making most successful efforts to prove that he was perfectly incapable of refinding it.

ISLAND OF FOULA.

*"Here no man dies—for all their necks are broke."**

There can be no reasonable doubt that this was the island—the Ultima Thule—seen by Agricola, from Orkney.

From the islands of Westray, Papa Westray, and North Ronaldshay it is, from its over-topping height, and from its also lying more directly to the north,† much more frequently seen than the Fitfiel Head.

Jameson tells us that from the Mainland of Shetland, the island of Foula forms a "tremendous object."

Having well nigh exhausted his vocabulary in describing the cliff scenery of the main group of the Shetlands, this author apparently is in somewhat of a dilemma when he comes to consider those of this outlier. The precipices of the Ord of Bressay are termed "frightful"—those of Noss "tremendous"—the Noup "stupendous"—Fitfiel Head "immense"—the rocks of Æthsting and Sandsting "awfully grand;"—but those of Foula have produced so powerful an impression that they are characterised as "terrific" and "most hideous." This latter expression must, however, have been employed to signify the nervous dread with which they had been contemplated. In its ordinary sense the word certainly most unfittingly expresses the character of the Foula cliffs, which are light and graceful in their contours,—massing with one another in grand combinations, and cutting the upper-air with a skyline in comparison with which the Ord of Bressay and the Fitfiel Head are altogether "hideous."

This island in the altitude, grandeur, and artistic features of its cliffs, very much surpasses everything else of the kind in Shetland.

From whatever side it is viewed, Foula, from the suddenness with which its hills rise from the ocean and the high angle of their slopes, does certainly appear as a startling and "tremendous object." From a base of about a couple of miles in both directions, five hills reaching a height of nearly fourteen hundred feet, spring up with little, and, on one side, no intermediate slope. On their eastern and southern

* From a volume of *original* poems, which will well repay perusal. By James Disher, Stornaway.

† Its distance, some twenty miles from the main group, is the sole difficulty in visiting this island. In Shetland the dangers of *landing* on this island are regarded as nearly insuperable: in the island the dangers to be encountered in *reaching* it are equally dreaded. In average weather these dangers exist only in the imagination.

sides these hills are steep; on their northern they can be scaled, bu only by the employment of *all* the limbs; on the west they either dro plumb, or even somewhat overhang the ocean in the first part of th descent; and this they do with most sudden precipitancy, there bein in many parts not only no preliminary slope, but not even a restin flat before the fall. From a steep and slippery grass-clad ascent upo the east, the rocks are cleft sheer down upon the west, leaving a edge so narrow that it must in some places be traversed in single fil

Though, from their vastness and from the nature of the rock, def cient in detail, yet for simplicity, chasteness of contour, and the effe of sublimity produced by their stupendous scale, these precipices as group, stand unrivalled in the British Islands.

With Orkney and Shetland dim-seen in the distance,—with bu small circlet of land set in the midst of a wide expanse of waters his feet,—with what is seen beneath of birds or crested waves dim ished almost to airy nothingness, the spectator feels as if perched space, and is thankful for that geologic faith which assures him th the perch is abundantly secure.

The five hills of Foula, enumerated from the north, are calle Comma Field or Soberly, The Kaim, The Sneug, Lorafield or Hamna field, and the Noup; it is a fair day's work to ascend all these hill and walk round the island.

Foula in the north and north-east consists of granite and gneis Hibbert mentions "slight indications of clay-slate having much t character of sandstone, into which it insensibly passes, so as to deserv little more than the name of argillaceous sandstone."

Also "slight indications of mica slate."

I did not find either of these rocks, but, in the south-east of th the island the sandstone at its junction with the other rocks, is of a ambiguous or ill-defined character.

This ambiguous rock extends from Schoble to a point calle Granite-geo. Captain Veitch calls it gneiss. Hibbert classes it a sandstone. I regard it as an argillaceous sandstone much altered, i places converted into a grit or gneissic-schist, and have little dou that there is here an actual transition from gneissic schists into rock Old Red Sandstone age.

Starting on the circuit of the island at Ham, the landing place, w find in walking northward, the lower and more gneissic beds of th transition rock, to some of which the name of *millstone grit* might b appropriately applied, so far as expressing its physical structure goe

The beds dip to the W.S.W. at an angle of 15° to 20°

They are cut off by granite,—or more correctly, there is a geo or fault twenty yards wide between them and the granite; the line of junction of the granite is E ½ S and W ½ N. The dip of the grit is altered to W. by S. with an angle of 30° just before the junction. Veins of the granite run along the strike, sometimes cutting the strata.

The granite is red like that of Roeness Hill, and must be more recent than the grit.

There supervenes a rock, generally a mica-schist, but sometimes a gneiss, through which veins of granite run along the strike of the strata, which, however, they sometimes cut. These veins consist of a pale granite, and, as noticed by Jameson, they are sometimes accompanied by veins of quartz.

At Sheep's Geo there are interstrata of hornblendic schist. The dip here is to the W.S.W., at an angle varying from 20° to 30° or more.

In these rocks there are nests of *green actynolite* (J.), and frequently *garnets*.

It has been stated that granitic veins run along the strike sometimes cutting the beds. The development of granite veins as seen in the low projecting tongue of rock which thrusts itself seaward, is the finest and most striking the writer has seen. The very peculiar form of this protruding mass of rock results from the way in which the rocks have been sea-worn at the junctions. Rectilinear and oft repeated lanes of water intersect the rocks, and, at all states of the tide, have cut off some rocky islets arranged in single file, and these are succeeded by sunken rocks. In these lanes or canals there is depth enough of water for a boat to traverse them, while they are so narrow, and disposed at such a distance from each other, that an active individual can proceed a considerable way seaward by springing from vein to vein,—the granite being generally the more enduring rock.

The junction with the sandstone takes place in a deep cleft called Wirwick. Although there is no granite here—except that of the veins, a very large one of which cuts the sandstone—the sandstone is much altered, having many of the features of quartzite, with a highly vitreous lustre. There is much contortion in the neighbourhood of the large granite vein Unfortunately the cleft, which is floored by deep water, prevents this vein being traced into a connection with any of those which cut the primary rock,—here a mica schist.

Specimens of *red quartz*, disposed in blotches in the yellowish grey sandstone here occur. (H.)

The dip of the arenaceous rocks where in contact with the mica-slate, is to the south-south-west, at an angle of about 72°; and as when

we pass westward we find the dip to be to the north of west at quite low angles, it becomes evident that there has been tilting.

That the tilting is in no way due to the mass of granite which tilted the strata at Granite Geo, is evident from the direction of the dip. There is no visible granite to the north-north-east of the gneiss; the dip of that gneiss at the extreme north point attainable at low water, is about 20°; at its southern extremity, just before its concealment under the turf, it is about 35°. It would therefore appear that the interstitial intrusion of the granite between the laminæ of the strata has *elevated it and the overlying sandstone in increasing amount as they passed southward.**

About the centre of the large open north bay the sandstone becomes very schistose and argillaceous, there are some thin strata of a dense blue impure limestone, and also of a singular micaceous "indurated" clay, with included bands of dense colloidal looking quartz which has filled up shrinkage cracks in the clay. These "cracks" being very much wider towards the centre of the mass than on the outside, a certain amount of septarian appearance is produced; but there is no honey-combing or circularity of arrangement. The structure is unique.

Following this, at the head of a small bight, there is some crushing, fracturing, and wedging, the origin of which is not apparent. There is the usual appearance of "induration," some little plication, and to the west, where the strata are again untroubled, the dip is more to the north.

The shores here commence to rise into cliffs with outlying rocks. One of these is of very singular form. This may be best conveyed to the reader by a comparison with a dog sitting on its haunches with its fore legs stiffened and its head erect; but the pillars representing the legs are much more massive than such a comparison conveys.

It is an insulated rock sloping rapidly towards the land, with its vertical sea face twice perforated by arched openings. One of these has pierced it laterally, while the second breach has, at right angles to the first, cut the prop into two.

As the rock is seemingly nearly two hundred feet in height, and the arches extend almost to the summit, it is a grandly imposing mass, beneath the dome of which an ordinary sized vessel, so far as space required is concerned, might easily pass.

Southward the sandstone is a loose grit. Its strata rise with extreme abruptness both from north and east, but especially from the former, into the ridge of Soberly, which overhangs the Atlantic in a

* The result being similar to what would be effected upon a bound book lying on a table, by the insertion of sheets of cardboard between the leaves.

line of precipices. These looked along in fore-shortening view, present a number of knuckle-like undulations, trending towards the slope of the loftier summit, the Kaim.

The whole of this ridge overhangs; at its northern end the precipice has a height of 671 feet, at its southern of 724.

The ascent of the north side of the Kaim demands (except from a Foula man), the aid of the hands. The summit is a mere pinnacle 1211 feet* above the waters at its base; these are altogether invisible except to one who lies down and extends his body over the verge.†

The manner in which the summit of the Kaim towers, lighthouse-like, above sea and land, surpasses anything the writer has seen, excepting the Myling Head, in Faröe. This much resembles the Kaim, but he found its height to be 2337 feet, while Captain Born made it 2500.

The Sneug, the highest hill in the island, rises steeply in its centre to a height of 1379 feet; it descends with almost inaccessible slopes on the north into two valleys.

Lora Field rises to the east with a height of 1176 feet. Somewhere on the northern slope near the summit of this hill, there is a chasm covered with a flag; this is called the Lum of Snifield. We have Hibbert's and other authority for the statement, that several barrel-fulls of lines have failed to plumb this crevass; but the author and a party of five, two of them being Foulaese, searched for it for some time unavailingly.

The whole mass of these hills consists of loose arenaceous yellow, red, and grey sandstones, very deficient in cement; their upper strata are frequently micaceous, occasionally being rendered flaggy thereby; and they also contain granules of a green powdery matter, in ignorance of the nature of which we might call it *chloritic*, but it has more resemblance to glauconite.

Southward of this line of three hills, the island is cut down to a low level, and nearly divided into two halves by a wide trench called Glen Dahl.

Near the cliffs at the western extremity of this, there is an enormous cleft in the land of about six feet wide at the surface and perhaps thrice that below; it is 100 feet deep, and approximately 300 yards in length. The rent surfaces accord perfectly with each other; this

* Captain Veitch made it 1233 feet.

† By so doing he will to the right observe a lower projecting point called the Little Kaim—say 500 feet high. This the writer was informed is "a terrible place for fools," the English of which is *an unrivalled place for catching birds.*

cleft runs at right angles to the line of coast; it has on the one side the three great hills last named, and on the south the huge towering mass of the Noup. Crevasses similar to this, but running parallel to a cliff line, frequently in Orkney give evidence of a coming fall—the sea having sapped the foundations,—but what has been the force which has operated here with such mighty buttresses on each side?

The precipices being here low, the cliff foot is seen to run out in bluish-black slabs, which dip to the S.W. at an angle of 12°; and, as on the south side of the Noup, the whole hill is seen to overhang to the south at a considerably greater angle, it is probable that this overhang, with a slip, has occasioned the rent.

The Noup rises from the Glen of Dahl—steep, smooth-sided, round-topped, and lumpish, to a height of 822 feet. Its domed summit slopes slightly towards a rough-edged precipice of nearly equal height; the hill falls with dangerously steep slope on the south, and terminates in the Ruskie Cliff, 452 feet in height.

The upper portion of this precipice at one spot overhangs to an extraordinary extent, projecting over the waters in a huge protruding mass of jointless rock, which constitutes nearly half the bulk of the precipice.

South of this the shores are lower; they exhibit long projecting shelves of rock all dipping to the S.W., and appearing from above—for they are inaccessible—somewhat like the argillaceous flags of the Old Red.

Returning to the east shore, we come again upon the gritty beds, and find their junction with, or rather transition into dark argillaceous and micaceous schists, to occur at Schoble. There is no unconformability. Here the dip is at first low, but it rapidly rises until at Ham Little there is a dip of 45° to 50°.

Sailing under the tremendous wall of cliffs of Muldi-couse, Wester Hyvda,* and the Kaim, two parallel and synchronously flexured bands of yellow and black striped rock, are to be seen about mid-way up the face of the cliff. These may each be about 80 or 90 feet in thickness—were it not for the abruptness of the flexures, they would have been set down as bedded traps.

* Wester Hyvda has in its centre a sloping bank of tufty grass of treacherous attachment to the rock; it is this sloping bank which is so dreaded by those men who, according to the Stornaway Bard, never die, though all get their necks broke. While standing on the summit of the Noup our party was startled by a sudden report; - turning at the sound in the direction of Wester Hydra a quantity of thin smoke was observed somewhat rapidly disappearing, a mass of fallen rock had by the tremendous blow been largely dissipated into sand

There is no spot where a cross section can be seen, but it is somewhat doubtful if the upper arenaceous beds are conformable with the flaggy layers.

Dr. Fleming mentions *Bituminous shale*, accompanied by thin beds of clay ironstone, as occurring, but does not specify the spot.

FAIR ISLE.

This mid-ocean stepping stone between Orkney and Shetland is, with its outlying stacks, composed solely of sandstones and sandy grits.

As it lies in the line of a continuation of the long strip of sandstone rocks of Shetland, and altogether to the east of a line connecting the two groups of islands, it is to be regarded as belonging geologically to the latter of these groups.

The same conclusion is borne out alike by the bold and bossy character of its shores and hills, the nature of the rock itself, and the occurrence of a copper vein with a north and south strike, which may not improbably be the continuation of that wrought at Sandlodge.

The island is by some considered to derive its name from its being situated in the *fairway* between Orkney and Shetland: by others from its having for the most part cliffy shores unincumbered with rocks; but to the writer it appears that in all probability the name has been a corruption from Far-öe—a Norwegian appellation which we still have both north, south, and east of this.

It has the enviable or unenviable celebrity of having arrested the galley of the Duke of Medina Sidonia, the Admiral of the Spanish Armada in his last desperate attempt to regain his country, after the destruction of his fleet. It has blocked the fair-way from the continent to America with like destructive result to many vessels up to very recent times; and from the thin mists which frequently cling to its heights, it must continue to do so until its claim to be the site of a a lighthouse of the first-class comes to be recognised.

With the exception of a little low ground in the south, the island is altogether of considerable elevation; and it is so girt with cliffs that there are but three landing places on its shore, two on the south, and one on its north-east in a somewhat land-locked bight. No one of these, however, is practicable in rough weather, unless the wind be off-shore.

In the north-easterly bight a small vessel might lie at anchor, with southerly winds.

It has been stated that a vein of copper-ore occurs in this island—it is on its west side. Though this has been lately attempted to be wrought, it was never properly explored; and it doubtless would yield several species besides those which have yet been noticed, if it ever came to be thoroughly opened up.

That most irrepressible naturalist the late Dr. Fleming, thus describes it, at its northern locality :—" it is situated in a mural precipice of sandstone, upwards of 300 feet in height, to the northward of Naversgill, and directly exposed to the western ocean. This vein intersects the strata in a perpendicular direction, and the line of its bearing is from north to south. Both sides of the vein seem to be composed of greenstone, and in the middle of the vein there is a stratum of soft decomposed rock, containing much clay and fragments of compact *heavy spar*. The principal ore is the *copper glance* or *vitreous copper-ore*. There is also a small quantity of *copper green* and *malachite*, disseminated through the copper glance. The vein of ore appeared to be only about six inches in breadth; but as at the time I examined this vein I was necessarily suspended by a rope from the top of the precipice, held by two of the natives, and was furnished with no other instrument than a hammer, I was unable to clear away so much of the decomposed matter as to enable me to get a distinct view of the magnitude of the vein, or the quantity of ore which it contained; and as the surge below prevented me from approaching the vein in a boat, my observations were necessarily confined."

Two specimens were brought to the writer from this spot by a nephew. The first was a massive vitreous ore which had much more the appearance of *fahlerz* than of vitreous copper.

The second was a peculiar fine granular yellowish-white stone of low gravity.

In a hasty and altogether incomplete analysis it yielded 4·97 per cent. of a yellow matter infusible in Fresenius, flux. The portion which dissolved in the flux yielded,—

Silica	51·825
Alumina (with some Fe^2O^3)	31·935
Lime (with some Ba O)	12·1
Magnesia	4·4
	100·26 (H.)

This may be only a gangue; but I have seen a substance indistinguishable from this from one of the Orkneys, where it carried malachite and azurite in cavities.

The same vein appears at the head of a wider geo to the east of Reevor Head, at a more southerly spot on the same western side of the island. Here it is nearly altogether concealed on account of explorations conducted in a quite trifling manner.

The island indeed has never been properly explored.

In the rocky shores of a small bight which is separated by a shingly beach or "ayre" from the little harbour of the east side of the island, *hone-stones* of considerable excellence are obtained.

The vast difference in the force of an Atlantic and of a North Sea billow is well displayed in the inequality in height of the cliffs on the west and on the east of this island. Among the interesting scenes of its intricately cleft shores, subterranean passages to the sea near Reevor Head, and the Screw or north-east point may be specially noted.

Some opinion as to the Geological age of these Islands may be expected before passing from a county which affords such unrivalled facilities in its winding shores for the examination of its rocks, which has supplied so many of the constituents of these rocks in such a state of purity as to be fitted for chemical examination—so many of these in those varying allomorphic conditions which afford every facility for change, and finally not a few localities where change incipient and complete is to be seen.

There are two directions in which correlation may be extended. First, with the rocks of the country in which they occur, or the rocks which the observer has himself examined; and secondly, with such as he draws his acquaintance with from the descriptions and writings of others. On the first of these points the writer is prepared to speak with such an amount of decision as is warranted by a close study of the older rocks of his country during many years; on the second, if he must speak at all, he does so with what he believes to be a very unusual amount of diffidence.

Such questions as these can only be entered upon after a due familiarity with the *literature* of the science; and, apart altogether from our ordinary acceptation of the signification of that word, Geology may be said to have a literature of its own, composed of sentences, words, and letters, as all other literature is.

In this special literature, *elements stand for the letters, minerals for the words, and rocks for the sentences*:—a thorough knowledge of these is as necessary for the proper compilation of the literature of geology, as is a knowledge of sentences, words, and letters to the proper appreciation of the structure of any written language; and yet it may freely be said that in much of the literature of Geology, there has not been over much deference paid to the importance of such knowledge.

Yet when the geologist steps from the fossil-bearing strata, to metamorphic and azoic rocks, such a knowledge is imperatively required.

How are the sentences to be construed and their import unfolded without an adequate knowledge of and acquaintance with their form of construction ?

"The question here arises whether in the absence of organic remains or of stratigraphical evidence, there exists any means of determining approximately the geological age of a given series of crystalline stratified rocks; in other words whether the chemical conditions which have presided over the formation of sedimentary rocks have so far varied in the course of ages as to impress upon these rocks marked chemical and mineralogical differences. In the case of unaltered sediments it would be difficult to arrive at any solution of this question without greatly multiplied analyses; but in the same rocks when altered *the crystalline minerals which are formed, being definite in their composition, and varying with the chemical constitution of the sediments, may perhaps to a certain extent become to the geologist what organic remains are in the unaltered rocks—a guide to the geological age and succession.*"

Geologists who are about to enter upon the study of the older rocks would do well to ponder on these words of Dr. Sterry Hunt; they would also do well to give due weight to the correct chemistry enunciated in the following, from the same author.

"In the case of the permeable or more highly siliceous class of sediments, whose chief elements are silica, alumina, and alkalies, the deposits of different ages will be marked chiefly by a progressive diminution in the amount of potash and more especially of the soda which they contain.

In the oldest rocks the proportion of alkali will be nearly or quite sufficient to form orthoclase or albite with the whole of the alumina present; but as the alkali diminishes, a portion of the alumina will crystallise, on the metamorphism of the sediments, in the form of a potash mica, such as muscovite or margarodite While the oxygen-ratio between the alumina and the alkali in the felspars just named is 3 : 1, it becomes 6 : 1 in margarodite and 12 : 1 in muscovite. The appearance of these micas in a rock denotes then a diminution in the amount of alkali, until in some strata the felspar almost entirely disappears, and the rock becomes a quartzose mica-schist. In sediments still further deprived of alkali metamorphism gives rise to schists filled with crystals of kyanite or of andulusite, which are simple silicates of alumina, into whose composition alkalies do not enter; or in case the sediments still retain oxide of iron, staurolite and iron-alumina garnet take their place. The matrix of all these minerals is generally a quartzose mica-schist. The last term in this exhaustive process ap-

pears to be represented by the disthene and pyrophyllite rocks, whic occur in some regions of crystalline schists."

Being at total dis-accord with Dr. Sterry Hunt as regards the origi of serpentine, it is a source of satisfaction to me to be able to point t the above as forming, in my opinion, correct leading-lines in geologic speculation; and I cannot but lay special weight upon the occurrence— if it be a clearly well-marked occurrence of certain mineral species, being a sure guide in correlation. Such occurrences must go far t prove both a general identity in the composition of rock masses, and general similarity in the circumstances in which they have been place and in the agencies which have affected them.

Making use here of the above leading-lines, the writer in answeri the first of the questions propounded, has to say that (excluding t sandstones lying to the east of the Cliff hills, and the sandstones w intercalated igneous rocks of the west coast), the older rocks Shetland (though some small masses of strata may resemble those other districts of Scotland), *form a group which occurs nowhere else in northern division of the kingdom*

The similitudes referred to within the brackets, were pointed out the time, and dwelt upon with all due, perhaps even an undue amou of force. These were, first, the resemblance of the Blue Mull an Fitfiel rock to that of Glen Rinnies and elsewhere, in Banffshire; an second, the very startling fact of the almost identity of the serpentin of Colafirth with those of Portsoy, in appearance, bulk, and strik but as regards the last, here the resemblance ends, for while the di at Colafirth accords with that at Portsoy, the latter is seen to be th normal dip, while that at Colafirth is not the normal, but hades awa from an eruptive rock. Little weight moreover could be laid upon a identity of dip at distances so extreme.

While then the above resemblances exist, they may perhaps be hel to be no more than resemblances, when full consideration is given t the following facts.

The schist of Banffshire is rendered typical by the presence o andalusite, chiastolite, staurolite, and kyanite: the Shetland roc never contains these, though two of them occur in the neighbourin gneiss.

The rocks associated with the serpentines of Colafirth and Portsoy though through the crudeness and bareness of lithological nomen clature bearing names nearly identical, are in their nature altogethe dissimilar. The Colafirth rock is a markedly schistose *albitic* rock the Portsoy one a porphyritic *labradoric* one.

So much for resemblances. The points in regard to which the Shetland group differs from the rocks of the mainland of Scotland, are these—

The general strike is not the same.

The prevailing dip is in the opposite direction.

The gneissic rocks are markedly deficient in felspar, and, when micaceous, invariably carry margarodite or muscovite, and only in one locality, an altogether trifling amount of Haughtonite or Lepidomelane.

The hornblendic beds of gneiss are super-imposed on those which are micaceous—in them the ingredients are usually arranged in markedly separate belts—the quartz almost disappears, and the felspar is *albite*.

The more perfectly schistose rocks are largely composed of allomorphs of hornblende, which ingredient, in its physical properties, then much simulates a magnesian mineral; while it very frequently shows itself as undergoing or having undergone a serpentinous change.

As a group they are signalised by vivid colours, considerable unctuosity, a highly crystalline structure, consequent brilliant lustre, high apparent metamorphism, and great age. They are also locally much disturbed by intrusions of large masses of igneous rocks.

Correlated with the rocks of Scotland, they do not appear quite so ancient as the hornblendic gneiss of the west coast, but markedly more highly metamorphosed than the conglomerates, schists, and gneissic rock which overlie that gneiss; there is therefore no class of rocks in Scotland with which to correlate them,—the Banffshire rocks seeming less old than they.

When we go further afield in our correlation, we have to cross to that New World, which, in geological age, is the Old; and in Dr. Sterry Hunt's description of the Upper Huronian system, with its hornblendic greenstones, with chlorite, steatite, serpentine, and soft margarodite schists, with occasional clayslate and magnesian limestone, I see a system so singularly according with the rocks of Shetland, that I believe that geologist would assign them to that horizon, —members of which he has already recognised in Perth and Argyle Shires.

Should the conjecture of Murchison and Geikie that the gneiss of the west coast is of Laurentian age prove to be correct, (as indeed there can be little doubt,) and should the Shetland rocks with equal correctness be assigned to the Huronian, then in the philite schists of Boharm and Clova, the andalusite schists of Coreen, the staurolitic

and andalusite schists of Kinnairdy, the quartzites and limeston of the Vale of Deskford, Ben Cullen, and away to the south, t serpentines, granular hornblendic rocks, chiastolite, and margarod schists of Portsoy, we have another series equally accordant with t Taconian of America.

This latter correlation, however, if the gneissoid rocks of the mid and east of Sutherland are truly Silurian—which is open to doubt would call for an immense upthrow in the line of the boulder-fil valley of the Spey; but it has to be noted that an identity in t gneissic rocks, which lie to the north and the south sides of the gr Caledonian Canal rent of Scotland, has never been shewn to be i doubted.

ADDENDUM.

Having directed Mr. Webster's attention to Dr. Fleming's notice the chromiferous magnetite occurring *in limestone*, near the Loch Trista, in Fetlar, he kindly made search and found the limestone.

It rises on the north shore of the loch, five or six feet above t level of the water, and crops up for some distance north of the lo Mr Webster states that it stretches in a line midway between Ha ma's Ness and Urister,—the peculiar appearance of the sahlite which latter place induced the author to suspect the near presence lime.

The Trista limestone contained the magnetite in minute angul specks. The specimens sent me by Mr. Webster consist of a yello ish, granular, loose-structured limestone, which carries an abundan of Biotite or phlogopite, and the magnetic mineral,—but no sphene.

According to Greg and Lettsom *andalusite* occurs in mica-slate Unst.

VI.—*Preliminary Notice of Substances which may prove to be New Minerals.*

By Professor Heddle.

Paper First.

AT Mr. Collins's request I submit to the members of the Mineralogical Society the following preliminary notice of substances which I have collected during my somewhat extensive wanderings about Scotland.

In the case of several of the substances described, it will be seen that I do not by any means bring them forward as being without doubt *new minerals*; of that, I have not satisfied myself, and still less can I hope to satisfy others, until specimens more fitted for absolute determination are obtained, and that in a quantity larger than what I have as yet had to operate upon.

The noting and describing these substances now, will enable others to lend their aid in the work.

It may be convenient to begin with such as occur in the northern counties, and in the present paper I confine myself to those found in the shires of Sutherland and Ross.

The names are of course to be held as being provisional.

Bhreckite (Vreckité.)

On the western slopes of the hill of Ben Bhreck, near Tongue in Sutherland, there lie, imbedded in till, two boulders of syenitic granite, which probably were derived from the neighbouring mountain of Ben Loyal, the rock of which is identical with that of the boulders.

One of these boulders was crossed by a granitic vein; this vein yielded in itself as many minerals as are frequently to be found in a whole county.

Being an exfiltration-vein the ingredients had crystallised in regular sequence from the sides, leaving here and there very small vacuous spaces in the centre; and the substance, to which I have attached the name of the hill, was one of the last, if not the very last to be deposited in these cavities.

It occurred in such very small quantity that nearly the whole had to be employed for the analysis.

The substance was deposited upon the surface of crystals of brown quartz, and its immediate associates were specular-iron and a calcareous strontianite.

In appearance it resembled a very fine-grained dense aphrosiderite; but its colour, being a light apple-green, was nearer to that of celadonite.

It was minutely granular or scaly; it was soft and friable.

What was analysed was to all appearance uniform and pure.

The analysis, executed on ·484 grammes, yielded,—

Silica	34·917
Alumina	7·158
Ferric Oxide	12·713
Ferrous Oxide	2·105
Manganous Oxide	·414
Lime	16·082
Magnesia	8·264
Water	17·768
	99·421

Of the above water 1·033 was lost at 212°.

There were traces of alkalies, but there was not enough material to determine them upon, separate quantities having to be used for the determination of the ferrous oxide, and of the water.

The mineral was freely soluble in chlorhydric acid.

By this feature it may be distinguished from all the so-called "chlorites," with the exception of glauconite; it likewise serves to distinguish it from celadonite.

From Delessite and the scaly varieties of saponite (which are soluble in chlorhydric acid), it differs in virtue of its large content of silica—a feature of its constitution which also serves to distinguish it from glauconite and the chlorites alike.

The calculation of its atomic constitution is as follows:

		Atoms.			
Silica	34·92	1·164		8	36·28
Alumina	7·16	·14	·3	2	7·78
Ferric Oxide	12·71	·16			12·1
Lime	16·08	·574	1·04	7	17·69
Magnesia	8·26	·413			8·46
Water	17·77	1·974		13	17·69

Atoms.

$$\dot{R}\ 7,\quad \ddot{R}_2\ 2,\quad \ddot{S}i\ 8,\quad \dot{H}_2\ 13$$

which give the percentages of the last column.

This is the only chlorite-like mineral which contains lime in quantity; if established as a species, it will stand next to chonicrite, and in composition it is not far removed from the metaxoite of Asp.

Xantholite.

Chondrodite is stated in several works to occur "near Loch Ness."

Loch Ness, being twenty-four miles in length, must certainly have fifty miles of shore, so that "near" is not very precise. The sentence is, however, not more deficient in precision than are many others in mineralogical directories.

It is true that the adjunct "in limestone" would appear to convey in the present case all the necessary information,—limestone being of very exceptional occurrence in the district in question, and only being found in quantity at one spot,—the Milltown of Glen Urquhart.

Neither Professor Maskelyne nor the writer could satisfy themselves that the one known specimen of "chondrodite from Loch Ness"—that in the British Museum—was that mineral. To the writer it appeared to be yellow serpentine; and, had it not been for the concomitant presence of arsenical-iron, he would without hesitation have said that the limestone matrix was that of Glen Elg.

In vain has he on several occasions sought long and diligently for chondrodite, both at Loch Ness, and in other limestone localities, but last summer when he in company with Dr. Aitken found the substance to which the above name is given, he believed that it had at last been found.

The mineral occurs a little to the east of the Free Church of Milltown, in a singular rock composed of large crystals of smaragditic edenite and a matted mass of interwoven plates of a highly calcareous Biotite, which much resembles talc.

Accessory minerals are fibrous Wollastonite, hydrous anthophyllite, currant-red garnet with minute imbedded zircons, and the mineral in question.

This occurs in rough crystals of the size of beans, so wrapped up in the Biotite as to appear to be nodular. When broken, the colour is seen to be intermediate between that of rosin and of cinnamonstone; when the mineral is bruised it has still more of a yellow tint. It is fissured throughout, but there is one very evident cleavage; the fracture is conchoidal, and the lustre of the fracture vitreous, but that of the cleavage

face is slightly pearly. The hardness is greater than that of the knife; but, from a minute amount of the Biotite lying in the fractures, it seems to be cut with the knife. It is reduced to powder with an amount of ease which, when its extreme hardness is considered, is singular.

No sound portion large enough for the determination of its specific gravity could be found.

The mineral was picked with extreme care, but the portion analysed might still have contained an inseparable trace of the Biotite.

Two analyses were made of the same quantity picked,—the first on 1·25, the second on 1· gramme.

There was obtained—

Silica	27·04	27·2
Alumina	45·858	45·965
Ferric Oxide	8·671	8·607
Ferrous Oxide	6·904	6·91
Manganous Oxide	·56	·5
Lime	3·808	3·528
Magnesia	4·32	4·5
Fluorine	·087	n.d.
Water	2·88	2·874
	100·128	100·084

It lost at 212° 0·64 of the water.

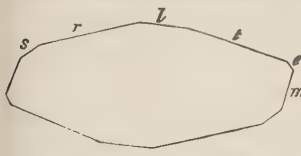
The only decided difference between the above and *grenatite* lies in the presence of lime and magnesia, and seeing that it is only lately that the presence of *both* oxides of iron has been noticed in grenatite, and that the formula of that mineral is hence still doubtful, it cannot be said that *this* might not, so far as composition is concerned, fall under the same formula.

What I have been able to make out of its crystalline form, however, points to its being distinct.

I have said that the nodular masses are rough crystals; such as I have been able to separate from the investing Biotite, seemed to indicate an oblique form.

The larger crystals are sometimes penetrated by smaller ones, which I at first took for zoizite—a mineral which occurs within a mile of the locality. Several of these penetrating crystals, however, having the same colour as the larger masses, I was inclined to think them pseudomorphs, until upon breaking them out I found that they had a perfect cleavage, with well-defined conchoidal fractures with a vitreous lustre.

These crystals, which occur of a resinous and also of a dark-green colour, are very minute. Examined by the microscope they have in section the form drawn. This, if not that of epidote, is very close to it; *l* sometimes instead of being a plane is a series of oscillations between *t* and *r*. The letters are appended conjecturally merely to show the position of *m*, which has a very perfect cleavage with a pearly lustre. There also appears to be a cleavage parallel to *l*, and the general lustre of these minute crystals is resinous.



On account of their want of size, I have not been able either to try the hardness of these crystals, or to attach them to the goniometer; their being the same substance as that analysed rests therefore only on extreme probability.

If they be the same, the material of *grenatite* is dimorphous, and calls for a second characterising name; the *colour* being here the most characteristic distinction, I have named the substance therefrom.

Dr. Aitken has lately found this substance of a somewhat redder tint at a locality about half a mile from that at which we first found it; this is in the cliffs of a small stream, north of the village of Milltown. Here the mineral was only in nodules, these were much fissured; the cracks were filled with a soft white steatite-like substance; this remained with a reticulated structure when the fissured mineral was dislodged from its grasp. A little Wollastonite was also here present.

Abriachanite.

This substance, which I name from one of the localities in which it occurs, was forwarded to me for examination by Mr. John Horne, of H.M. Geological Survey. The portion sent was, I understand, found by the members of the Inverness Field Club, during one of their excursions.

As Mr. Horne was not able to put in my hands a sufficiency of material for a complete examination, he referred me to our fellow-member, Dr. Thomas Aitken.

Dr. Aitken sent me a further supply, but inasmuch as from the nature of the specimens as ordinarily collected, they were not fitted for analysis, I found it necessary to visit several of the localities, under Dr. Aitken's guidance; I there collected the varieties of the mineral with my own hands, and was thus enabled to obtain it in as great a state of purity as was possible.

Dr. Aitken having undertaken to supply the history of the mineral as regards its localities I need say little on that head.

To myself the modes of its occurrence appear so unusual and inexplicable, when considered as a whole,—that a few words on the geology of the district are desiderated.

So far as I know it is confined to a geographical limit of about six miles square, this square lying to the west of the town of Inverness, at a distance of about six or seven miles.

The chief rock of this district is a gneiss, which has been assigned to Silurian age.

It is a rock altogether ill-defined as a gneiss, is very argillaceous, and one which for a north-country rock has suffered but little metamorphism.

Overlying this gneiss, in about the centre of the district in which the mineral is found, there occurs a bossy outlier of the Old Red Sandstone conglomerate. Outwardly, it rises in craggy knolls; inwardly, it consists of much-rounded and marvellously diversified nodules of rocks, which had been markedly more highly metamorphosed than the underlying gneiss.

A few miles westward of the flanks of this mass of conglomerate there occurs a very circumscribed hill of red granite of a fine grain; this granite is somewhat hornblendic in composition, it is different from any other granite which I have seen in Scotland.

Between the granitic hill and that part of the gneiss which is overlaid by the conglomerate, the gneiss is considerably brecciated, and it is occasionally riddled by granite veins, these being however of a nature totally dissimilar to the red granite of the western hill.

Where the gneiss approaches the conglomerate the breccia is quite loose, hardly coherent in its parts, being quite open in its structure, and undergoing rapid ærial decomposition.

The arrangement of its parts does not in any way convey the impression that it is a fundamental breccia of the Old Red formation.

In the northern portion of the space indicated, there are bands of a poor limestone, with interbedded Steatite and Saponite.

It may be almost said that the gneiss, the rotting breccia, the granite veins, and the vein-stone of the lime, are alike saturated and pervaded with the mineral described; this, from its colour, has for a year of speculation as to its nature, been called "the blue mineral."

The specimens furnished me by Mr. Horne were of two sorts.

The first consisted of shattery and sharp-angled fragments of the dull brown and muddy looking gneiss, on the surfaces of and filling the many rents of which there were thin films of a pale to a deep blue coating, which had a somewhat glossy lustre.

The second consisted of putty-like lumps of a blue clay, which showed the impression of the fingers which had lifted it while soft; this clay contained imbedded fragments of lycopodia and mosses, with patches of a red-coloured substance.

The finer and purer bits of the first variety showed under a magnifier a fine fibrous structure, the fibres of which were transverse to the thickness of the veins,—they thus somewhat resemble crocidolite: the second somewhat resembled the earthy variety of Vivianite, though the structure was not loose enough or granular enough to make the resemblance complete.

The first of the localities to which I (in company with Mr. Horne) was conducted by Dr. Aitkin, was a road cutting in process of construction near Dochfour; this was being carried through the loose breccia. Both of the above varieties were to be seen here in abundance; and it was sufficiently evident that the second was merely an enlarged development of the first, in a less pure form.

Every rent—and the rock was pervaded with innumerable rents—was plugged with the mineral, from seams more delicate than tissue paper to vein-structure of over an inch in width.

Out of the larger veins the pulpy clay could be dug with the blade of a knife; and it was held in suspension as a blue cream in the ditches at the foot of the cutting.

The appearance and mode of occurrence were such as to induce a confident assertion that it was merely kaolin stained of a peculiar tint.

The breaking into the rock to a depth of little more than a foot, however enabled us to get rid of surface moisture, and sufficed to show the fallacy of the above opinion, for the mineral was then seen to fill the vein, not as a kaolinic powder, but as a solid, though much fissured schistose stone.

Fragments of this dry solid stone when placed suddenly in water, fell to pieces like bole, swelled up considerably, rapidly tinged the water blue, could almost immediately be worked up by the fingers into a slimy clay, and from which there could be separated a few unaltered fragments, both of quartz and of a red and gritty powder.

A sufficiency of the substance in its *three* varieties was here collected.

So far from being inexplicable, there could not be anything more normal than the occurrence, in circumstances such as the above, of any mineral which was manifestly a product of decomposition.

There is to me at least something altogether inexplicable in the mode of occurrence of such a substance, at the second of the localities to which we were guided by Dr. Aitken.

This was the deep water-cut bed of the torrent called Dochfour Burn.

The smooth water-worn floor of this cañon-like gorge has been cut down to a depth of some 40 feet at its embouchure, and to a much greater depth a short way up its course. The gneiss of its bed has here suffered from no apparent change, for the rock is firm and unshattered, and the deep trench has exposed it, and is ever re-exposing it, so that only recent change can possibly affect it.

The gneiss itself shows here but little trace of the mineral; but in granitic veins which ramify throughout it in the very bed of the stream, and on the lip of a cascade, the mineral occurs in veins which are not the fillings up of opened shatterings, but which are firmly coherent, as are the other parts of the granite.

These granitic veins were broken into until our tools gave way. They were everywhere perfectly fresh and unchanged, the felspar bright and lustrous, and firmly coherent to the quartz: yet there, break it in what direction we pleased, was the blue mineral, occurring in veins from the thickness of an eighth of an inch to the thinnest of films.

The third locality at which Dr. Aitken and I observed the mineral was at the limestone quarry of Reelig. Here it filled thin fissures of the gneiss as at the first locality, and was also seen in a coarse crumbling granitic belt of the same rock.

In describing the mineral itself we have to note it in its three appearances.

First, as it occurs in thin veins with a transversely fibrous structure.

The material of these veins when they are exposed by the removal of one part of the rock which had enclosed them, is frequently seen to be in a singularly shattered condition, different portions of the little vein lying apart, and sometimes being adherent to the rock in an evidently false position. The fibres are somewhat paler in colour than is the surface formed by their terminations,—they have a high silky lustre. The colour is a pale blue to nearly white. They are easily crushed between the fingers.

The schistose variety was very splintery, the cleavages or rents forming the splinters lay somewhat parallel to the sides of the vein which contained them. This variety was harder than the last and had a specific gravity of 3·326.

The last variety,—the "clay,"—was formed by the saturation of that just mentioned, by water. It was very soft, smeared the fingers and clothes on contact, and when stirred up with water went almost entirely into suspension.

Upon decanting the suspended particles from the impure sediment, the whole mass of liquid was seen to have a silky appearance, resembling, upon agitation, the twisted interwoven structure of mother-of-pearl, or *moire metallique.*

A drop examined by the microscope was seen to be filled with minute fractured fibres; so that this clay-like variety is nothing more than a coherent mass formed of the interlacing fibres of the first variety.

Being unable to obtain anything like a sufficiency of the fibrous mineral, my first analysis was made on the chips which I picked out of a vertical vein at Dochfour.

The specific gravity taken on a piece of 17·8 grains was 3·326.

The chips were cut down with the pliars to about the size of small shot, some little amount of red gritty matter being removed in the so doing. After purification as far as removal of all impurity visible to a lens, they were crushed in the diamond mortar, and pounded. During the pounding, however, red streaks appeared, and gritty matter was felt under the pestle; this was as far as possible removed, and after fusion with Fresenius flux, there was obtained from 1·001 gramme.

Silica	51·148
Ferric Oxide	14·921
Ferrous Oxide	9·803
Manganous Oxide	·299
Lime	1·118
Magnesia	10·803
Potash	·63
Soda	6·518
Water	4·772
Sulphur	not det.
	100·012

Of the above water ·948 were lost at 212°. As the red matter could not have been absolutely removed, this can be no more than a close approximation to the true composition,—the quantity of ferric oxide being doubtless too high.

B. B.—the mineral imparts to the flame a strong sodium reaction. With fluxes it gives the iron reactions. It fuses with difficulty into a blebby black glass, which is strongly magnetic. Its powder is insoluble in all acids.

The clay-like mass was picked as free as possible from all visible or tangible impurity under a lens; it was then rubbed up into a cream in a mortar with water, and the suspended portion decanted into a large jar of water. It was decanted several times from the heavier and coarser portions, and then set aside to subside from a large quantity of liquid. It settled with such extreme slowness that seven weeks elapsed before a sufficiency had subsided. This was obtained by the decantation of what was still in suspension, and drying the residue first in a water bath, and ultimately, when approaching dryness, in dry air. The colour of the material thus obtained was very fine and pure,—being like a pale ultramarine.

1· gramme of this sediment afforded—

		Atoms.	
Silica ..	52·4 ..	1·75	1·75
Ferric Oxide	9·339 ..	·117	·117
Ferrous Oxide	15·171 ..	·421	
Manganous Oxide	·4		
Lime.. ..	1·176 ..	·063	
Magnesia ..	10·5 ..	·521	1·581
Potash ..	·614 ..	·013	
Soda.. ..	7·106 ..	·229	
Water ..	2·968 ..	·33	
Sulphur ..	1· ..	·063	
	100·674		

Of the above water ·57 were lost at 212°. No alumina was found. As a check on this point the total iron was determined by potash precipitation,—by ammonia,—and by titration;

There was got

By Potash ..	26·25	Ferric Oxide
Ammonia ..	26·25	
Titration ..	26·1	

Sediment which has settled after four months suspension is hardly any finer in colour than what was examined; so that the sedimented clay

may be regarded as being next in purity to the fibrous variety of the mineral.

Of the above analysis it may be said in the first place that there can be little doubt that the colour is due, as in ultramarine, to a ferruginous sulphuret of sodium.

The atomic ratios, as calculated out, hardly enable us to conjecture the true manner in which the ingredients are arranged; the atoms of the bases nearly balance those of the silica, so that probably it is a normal silicate.

It has been supposed that this substance was at one time utilised as a pigment in Inverness:—the ease with which it can be purified by washing, and decantation, and the delicacy of its colour—a kind of lively neutral tint—give very considerable countenance to this conjecture.

It will doubtless appear that, (while no more care and trouble has been taken in the determination of the nature of this substance than is called for in any and every case,) there has been much prolixity in the detail of the process employed for securing purity of material—as also of the modes of occurrence of the substance; the reason of this is *the absolute inability of the writer to account for its formation*, not to say for its almost universal distribution in the district in which it is found, and its entire absence from the same class of rocks beyond that district.

It did at first appear—from the open and decayed condition of the rock at Dochfour, and the occurrence of vegetable matter in its proximity,—as if it might be the product of an action of vegetable acids on the felspathic ingredient of the rock; but any such view must be absolutely set aside in presence of the following facts.

It was obtained by the writer from a portion of the rock at Dochfour, which, while it might have suffered from ordinary decay or alteration, was in no way exposed to the influence of the products of vegetable decay.

It is to be found in the interior of perfectly unaltered granitic veins, which are in no proximity whatever to vegetable matter.

The composition not only is not of the nature of kaolin, but from the absence of alumina is altogether different from it.

The composition in no way gives countenance to the view that the substance is the product of a change resulting from the action or influence of vegetable matter.

But the difficulty does not end here. While its occurrence in the shattered and changing rock at Dochfour,—the transverse arrangement of its fibres,—and the feeble grasp with which it holds together the fissured

portions of the rock indicate, that it is at Dochfour and Reelig *a product of change*, its composition as such is very singular, for the rock does not visibly show the presence of any pyrites, or mineral capable of yielding the sulphur. While apparently (it must be borne in mind that the identity has not been proved by analysis) the same substance occurs in granitic veins in circumstances which give no countenance to our regarding it as *the product of a change of any kind.**

The attaining to any conception of the mode of formation of this Scottish ultramarine, is to the writer as difficult as was the attaining to the actual formation of true ultramarine to the chemists of a former generation, and probably can only be arrived at by an analysis of the unaltered, and also of the much altered rock-matrix.

---

* The granite veins in the Dochfour Burn which carry the mineral show rare minute specks of pyrite,—these are apparently quite unaltered; the mineral here paler in colour than is usual.

VII.—*Note on the modes of occurrence and localities of Abriachanite,*

By Thomas Aitkin, M.D. Inverness.

THE blue substance first came under my observation many years ago in one of the Slickensides, in the first quarry opened for the supply of Abriachan granite, and situated by the side of the road leading to Abriachan,—a somewhat isolated district amongst the hills overlooking Loch Ness.

It was then seen in purplish-blue spots, dotting here and there the surface of the rocks which had been exposed to considerable weathering, and over which water had poured freely.

Since then it has been found all along this ridge wherever the granite has been exposed, in patches of greater or less extent, on the surface, or in the cracks of the felspathic veins traversing the gneiss; —in many of the masses of rock fallen from the cliffs,—along the shores of the Loch,—and covering the gneissose blocks met with in considerable quantities in the Allt Cuig, a narrow burn immediately beyond the Loch-End Inn, a little more than six miles from Inverness.

Here it was first observed in what is its purest condition, in small rectangular looking masses of delicate and microscopic fibrous crystals of a bluish silky lustre.

It has also been found in narrow seams in the granite veins which force their way through the rocks of the Dochfour Burn, at the picturesque waterfall immediately above the bridge in the private road leading to Dochfour House.

Its greatest developement, however,—except at one station to be afterwards described,—is at a short distance east of the point last referred to, in an excavation made for metalling the road mentioned, at a spot where the rock is considerably shattered; this is possibly the result of a neighbouring fault, and the rock has been here much exposed to weathering and other disintegrating agencies.

At one period indeed during the summer, this road (formed by taking skillful advantage of one the numerous Kames forming so striking a feature at the mouth of the Great Glen,) presented where the material

was newly thrown down, a beautiful and brilliant blue color, which at once attracted attention.

At this point the mineral was noted in the crevices and cracks of the rock, or covering its surface in the form of a soft unctuous clay; in this, when examined microscopically, the beautiful and delicate parts already mentioned could be seen.

It has also been met with in numerous boulders apparently from the Abriachan district, scattered as far eastward as the Leachkin,—the face of the hill between Dunain and Craig Phadrick,—in the water-rolled pebbles and blocks in the gravel ridge running from Jorvain up to the foot of the Dunain Hill, and in one are two fragments of mica-schist picked from one of the stone heaps on the top of the Leachkin.

To the west of and behind Dunain extends a district known as Englishton Moor, and over this quantities of scattered boulders lie,—these contain the blue material in abundance.

After the development, however, mentioned by the side of the new approach to Dochfour House, it has been observed in largest quantities in the Reelig Burn. Here it is seen where the surface of the rock is exposed immediately below the mansion house of Reelig, and also lower down in masses of rocks which had perhaps fallen down during the preceding winter, into the bed of the burn, and not far from where some rude arches of stone-work exist.

The most striking aspect however which it has been seen to present was met with at the Limestone Quarry now being worked not far from the point last mentioned.

In one of the old workings on the surface of a large mass of rock which had recently fallen, the half was observed to be of a bright red colour from a coating of reddle or some similar substance, whilst the other half presented as seen in the bright sunlight, a dazzling blue appearance.

The district indicated in the foregoing description will be best understood by reference to Professor Geikie's or Professor Nicol's Geological Map of Scotland, and comprises roughly an extent included within a line drawn from the middle of the granite region on the north western shore of Loch Ness, to the burn shown as finding its way into the Beauty Firth at Kirkhill. It must not however be understood that the mineral may not be found beyond this area, but investigation has not extended beyond this in a westerly direction; and it was not picked up in Glen Urquhart during last summer in frequent excursions made to this part of the country.

The mineral itself is *apparently* connected with the disintegration and decomposition of the felspar contained in the various rocks of this district. It occurs as already remarked in various forms ; covering the surface of the rocks in which it is found with a fibrous bluish-white silky-like coating, or a bluish-white powder, or in seams of a more or less dark-blue tint.

It has also been met with of a whitish-blue colour, generally diffused through fragments of gneissose rock, picked up in the Allt Cuig Burn ; and lastly it has been obtained in what is believed to be its purest form, in the minute rectangular masses composed of delicate microscopic fibres of a silky lustre, and of a bluish colour.

VIII.—*On Haughtonite; a new Mica.*

By Professor Heddle.

DR. HAUGHTON, by his numerous analyses of the black mica of the Irish granites, may be said to have established the specific individuality of the *lepidomelane* of Hausmann.

That mineral his analyses showed to differ from Biotite in its great excess of ferric oxide and its comparative deficiency of ferrous oxide and magnesia.

The oxygen-ratios of Irish lepidomelanes as compared with Scotch Biotites are as follows:—

	Lepidomelane.	Biotite.
Silica	20 ..	21
Peroxides	15·5 ..	8
Protoxides and water ..	7 ..	15

there being thus an inversion of the relative proportions of the bases.

Lepidomelane is somewhat heavier and somewhat harder than Biotite;—in other properties the minerals are similar.

I had occasion some years ago to observe that the black-scale mica of the Scotch granites and granitic dykes and rock-belts, contained much the largest proportion of its iron in the *ferrous* condition,—thus differing from lepidomelane; and that they contained very little magnesia, and thus differed from Biotite.

I also found that while in Scotland Biotite was confined to limestone and serpentinous rocks, *this* black-scale mica was never found therein, but was confined to the rock matrices I have above named.

A sufficiency of analyses have shown this Scotch mica to be altogether distinct; and I propose to name it after Dr. Haughton, whose work among the micas and granites in every way entitles him to honourable recognition.

Physically this new mica is somewhat heavier and somewhat harder than lepidomelane, and its characters as a whole give it a position which places lepidomelane as an intermediate between it and Biotite.

In submitting the analyses I have made of this mineral, I arrange them in geologic sequence, commencing with the deeper-seated rocks and rising in succession to the more recent.

Occurrences in hornblendic (Laurentian) gneiss.

The mineral may occur in the general mass, or in the felspathic bands of this rock, but I have not yet got it in quantity sufficient for analysis. I have though obtained it in the former, in specimens sufficiently characteristic for recognition.

In the granitic veins which cut the rock it occurs in much the finest specimens that I have seen.

In the southern part of Harris a number of huge dykes cut the gneissic beds, generally at right angles.

A great dyke of this description is to be seen on the north-east side of the hill of Roneval; it is glaciated so as to be polished as well as rounded. It is so dense and solid that our heaviest hammers could not find a weak joint to attack; but my friend Mr. Dudgeon and I measured many edges of worn-down crystals of this black mica, which were over a foot in length. We had to content ourselves, however, with merely a quantity of chips sufficient for analysis;—this was, from the same cause, also the case with the magnetite which accompanied it. Only blasting tools could here effect more.

The mineral is here jet-black, transmitting light of a dark brown tint when in very thin plates. It is slightly biaxial, very tough, and so is powdered with great difficulty; the powder is black with a slight shade of green. Its specific gravity is 3·03.

Its analysis yielded—

Silica	37·164
Alumina	15·006
Ferric Oxide	7·689
Ferrous Oxide	17·353
Manganous Oxide	1·044
Lime	1·128
Magnesia	8·88
Potash	8·18
Soda	1·605
Water	2·121
	100·160

About two thirds of the water is lost at 212°, the rest is retained with extreme tenacity.

2. There is an enormous dyke which cuts through the east foot of the hill of Capval, in the south west of the same island. This dyke contains many substances, but this one only in small quantity, and in a mode of arrangement different from that of the Roneval mineral.

At Roneval the crystals were isolated and lay in almost every direction; at Capval they were in divergent groups of elongated crystals. The colour was jet black, they were slightly biaxial. Their specific gravity was 3·071.

They yielded—

Silica	36·806
Alumina	15·22
Ferric Oxide	7·611
Ferrous Oxide	17·353
Manganous Oxide	·96
Lime	1·54
Magnesia	8·784
Potash	8·31
Soda	1·342
Water	2·47
	100·396

3. Further north on the west coast of the same island, at a point intermediate between Nishibost and Borve, there is a mass of fine-grained granite of such dimensions that I could not ascertain whether or not it was to be regarded as a vein. This granite is itself riddled with exfiltration veins, and in these the mineral is found in crystalline plates of a most brilliant lustre and a colour of pitchy blackness. Occasionally here, however, the edges of the plates are coated with a bright-red rust. They are biaxial to the extent of 2° or 3°, and their specific gravity is 3·05.

They yielded—

Silica	35·154
Alumina	16·704
Ferric Oxide	5·961
Ferrous Oxide	19·063
Manganous Oxide	1·016
Lime	·818
Magnesia	7·461
Potash	9·243
Soda	1·259
Water	3·133
	99·812

4. Still further north on the west coast of the same island, but now in the portion of it called Lewis, the same mineral occurs. The locality from which we took the specimens was the north shore of a small fresh-

water lake called Loch-na-Muilne, which is situated near the north shore of Loch Roag.

The specimens were again in granite veins, but here oligoclase was along with orthoclase an associate. The colour was dark-brown to black.

Analysis gave—

Silica	36·461
Alumina	17·253
Ferric Oxide	4·18
Ferrous Oxide	15·325
Manganous Oxide	·538
Lime	·689
Magnesia	12·23
Potash	9·204
Soda	·657
Water	3·385
	99·922

Of the water ·325 was lost at 212°.

5. Crossing to the mainland of Scotland, we find the same mineral in the same rock, and in the same association.

It may be said to be everywhere seen in the granitic veins, though it does not always occur in quantity sufficient for analysis, or even for the obtaining characteristic specimens.

The western slope of the great hill of Fionaven in Sutherland carries, at a height of 750 feet, a number of large veins. These are for the most part made up of orthoclase and oligoclase. Haughtonite is here very rare, but it is in the most lustrous and jetty-black plates that I have seen. The plates seemed here to be hexagonal.

Their specific gravity is 3·032.

They yielded—

Silica	36·75
Alumina	17·858
Ferric Oxide	2·781
Ferrous Oxide	15·175
Manganous Oxide	·416
Lime	·933
Magnesia	11·166
Potash	9·437
Soda	1·247
Water	4.232
	99·995

Of the above water ·967 was lost at 212°.

6. From a fallen mass of a granitic nature which lay near the soutl shore of Loch Stack, in the same county, I got larger plates of th mineral. The mass was angular and fresh, and probably had formec part of a vein in the overshadowing precipice of Ben Stack.

The mineral here was of a brown-black colour—not so lustrous a elsewhere. Its powder was somewhat greenish, its specific gravity wa 3·05.

Its analysis gave

Silica	35·692
Alumina	20·086
Ferric Oxide	2·233
Ferrous Oxide	14·011
Manganous Oxide	1·
Lime	1·895
Magnesia	14·769
Potash	7·381
Soda	·529
Water	2·465
	100·061

7. A tortuous and nodular vein of red graphic-granite is imbedded in the gneiss on the north side of the little harbour of Rispond, on th west shore of Loch Erribol. Magnetite, oligoclase, and Haughtonit occur in this.

The Haughtonite is here present in small jet-black plates of a high lustre; and in large brownish ones of less lustre.

The black was analysed; its specific is 2·99.

It gave

Silica	36·538
Alumina	22·282
Ferric Oxide	2·433
Ferrous Oxide	16·009
Manganous Oxide	·784
Lime	1·249
Magnesia	10·
Potash	8·264
Soda	·794
Water	1·506
	99·856

From the Felspathic Belts of Micaceous Gneiss.

8. In the rocky face of the rounded hill called Clach-an-Eoin between the mouths of the Navir and the Borgie in Sutherland, the micaceous gneiss contains this mineral in somewhat large plates, though not in large amount. The worn edges of the crystals present themselves, and though the mineral is on its cleavage planes brown, these edges have a blue tint, and bear a singular resemblance to tarnished metallic lead. The associates here are garnet, rutile in crystals, ilmenite and chlorite —all are imbedded in quartz.

The plates of mica are clove-brown in colour, and reddish-brown by transmitted light. They are slightly biaxial.

Their specific gravity is 2·96.

They yielded—

Silica	35·846
Alumina	21·539
Ferric Oxide	4·467
Ferrous Oxide	18·306
Manganous Oxide	·307
Lime	1·249
Magnesia	8·076
Potash	7·759
Soda	·794
Water	1·956
	100·299

From intrusive veins in Micaceous Gneiss.

9. A vein of pale lavendar almost white microcline cuts the gneissic or greywacke schists with a semicircular sweep, immediately to the north of the lighthouse at Kinnaird's Head in Aberdeenshire.

This contains the mineral in very dark crystals, which, when split thin, have a fine rich dark-green colour. A small quantity of radiated Cleavelandite is also imbedded in the microcline.

The Haughtonite here is brittle, and pounds with unusual facility. It is hardly perceptibly biaxial. Its specific gravity is 3·126.

Its analysis gave—

Silica	35·666
Alumina	17·947
Ferric Oxide	7·191
Ferrous Oxide	18·063
Manganous Oxide	2·
Lime	1·4
Magnesia	1·5
Potash	9·273
Soda	3·81
Water	3·2
	100·050

This differs from all the others not only in its colour, but in the small quantity of magnesia which is present.

The locality was discovered by a former pupil Mr. James Wilson of the Geological Survey.

From Intrusive Veins in Granite.

10. In the granite quarry of Cove, five miles south of Aberdeen, the veins carry the mineral in a peculiar association with Muscovite. Elongated crystals of the Haughtonite lie imbedded in crystals of Muscovite parallel to their larger diagonal.

It requires some force to tear the plates of the one mica separate from the other. This close consorting is singular, as the two are seldom even associated in the same rock or locality.

The colour here is brown. It is uniaxial.

Analysis gave—

Silica	35·469
Alumina	18·798
Ferric Oxide	4·611
Ferrous Oxide	19·188
Manganous Oxide	·643
Lime	·904
Magnesia	7·007
Potash	8·188
Soda	·238
Water	4·97
	100·016

From exfiltration veins in Syenitic Granite.

11. The fine-grained granite which forms the little hill of Cnoc-dubh about a mile east of Lairg in Sutherland, carries in its mass small crystals of sphene and hornblende.

A vein of a foot or two in width traverses it on its north side, and from this quite an assemblage of minerals were got.

Orthoclase, oligoclase, sphene, allanite, and this mineral, in long, narrow, pale-green crystals with a somewhat greasy lustre, and a slight appearance of decomposition all occur here. Those which were deep-seated were of the usual brown colour.

The plates here were so twisted that none sufficiently large for ascertaining either the optical properties or the specific gravity could be found.

The analysis gave—

Silica	35·555
Alumina	16·694
Ferric Oxide	1·883
Ferrous Oxide	18·037
Manganous Oxide	·694
Lime	2·722
Magnesia	8·472
Potash	9·896
Soda	·105
Water	5·714
	99·722

From Diorite.

12. There is a good deal of a dark mica throughout the dioritic rocks of Banffshire in certain localities.

This mica would appear to replace the hornblende, for in some parts of the county, as near Rhynie, the rock contains only labradorite and the mica.

Only at one spot, however, have I succeeded in getting a sufficiently large mass for analysis, so I am unable to say that all the dark mica of this rock is of the same nature; it has in many places, especially in the veins, very much the appearance of Biotite.

The locality where the mass was obtained was the west shore of the bay of the Durn near Portsoy, where by a chance-find, a portion of a vein some pounds in weight was got.

It consisted of a mass of crystals twisted into one another in most confused arrangement; the colour was a somewhat bronzy-brown; the lustre greasy and glimmering, the specific gravity 3·074.

The composition is—

Silica	34·076
Alumina	17·339
Ferric Oxide	3·613
Ferrous Oxide	18·703
Manganous Oxide	·384
Lime	3·23
Magnesia	10·538
Potash	6·78
Soda	1·193
Water	4·052
	99·908

I have also analysed specimens of doubtless the same mineral from near Cape Wrath and from the Clova Hills in Aberdeenshire; but the specimens from the former locality had apparently suffered peroxidation, while those from the latter were possibly contaminated with the gneissic matrix.

Twelve fairly closely accordant analyses from seven diverse geognostic habitats are, however, amply sufficient for estimating the claims of any substance to be considered entitled to specific distinction.

The following table presents the general accordance in composition to the eye.

	Sp. G.	$\ddot{Si}$.	$\ddot{\ddot{Al}}_2$.	$\ddot{\ddot{Fe}}_2$.	$\dot{Fe}$.	$\dot{Mn}$.	$\dot{Ca}$.	$\dot{Mg}$.	$\dot{K}_2$.	$\ddot{Na}_2$.	$\dot{H}_2$.	Total.
Roneval	3·03	37·16	15·	7·69	17·35	1·04	1·3	8·88	8·18	1·6	2·12	100·17
Capval	3·07	36·81	15·22	7·61	17·35	·96	1·54	8·78	8 31	1·34	2·47	100·40
Nishibost	3·05	35·15	16 7	5·96	19·06	1·02	·82	7·46	9·24	1·26	3·13	99 81
Loch-na Muilne ...		36·46	17·25	4·18	15·33	·54	·69	12·23	9·2	·66	3·39	99·92
Foinaven	3·03	36·75	7·86	2·78	15·18	·42	·93	11·17	9·44	1·25	4·23	99·99
Ben Stack	3·05	35·69	20·09	2·23	14·01	1·	1 89	14·77	7·38	·53	2·47	100·06
Rispond	2·99	36·54	22·28	2·43	16·01	·78	1·25	10·	8·26	·79	1·51	99·86
Clach-an-Eoin ...	2·96	35·85	21·54	4·48	18·31	·31	1·25	8·08	7·76	·79	1·96	100·33
Kinnaird's Head ...	3·13	35·67	17·95	7·19	18·06	2·	1·4	1·5	9·27	3·81	3·2	100·05
Cove...		35·47	18·8	4 61	19·19	·64	·9	7·01	8·19	·24	4·97	100·02
Lairg		35·56	16·69	1·88	18·04	·69	2·72	8·47	9·9	·11	5·71	99·77
Portsoy	3·07	34·08	17·34	3·61	18·70	·38	3·23	10·54	6·78	1·19	4·05	99·9
Average	3·04	35·93	18·06	4·55	18·06	·81	1·49	9·07	8 49	1·12	3·27	

The averages of the twelve, and the oxygen ratios are as follows :—

		Oxygen.		
Silica	35·93	19·16	19·16	19
Alumina ..	18·06	8·41	9·78	10
Ferric Oxide	4·55	1·37		
Ferrous Oxide	18·06	3·8	12·67	12·5
Manganous Oxide	·81	·18		
Lime	1·49	·42		
Magnesia ..	9·07	3·63		
Potash	8·49	1·44		
Soda	1·12	·29		
Water	3·27	2·91		

These ratios are so different from those of lepidomelane and of Biotite, as to leave no room for doubt that the mineral is quite distinct from either.

But the question is,—is it new? It is new as regards its specific individuality being now for the first time indicated, but not new as regards its being now for the first time analysed. From Dana's table of analyses of Biotite I select three, to which I have added two from a more recent source.

	$\ddot{S}i$	$\ddot{A}l_2$	$\ddot{F}e_2$	$\dot{F}e$	$\dot{M}n$.	$\dot{C}a$	$\dot{M}g$.	$\dot{K}_2$	$\dot{N}a_2$	$\dot{H}_2$	Total.
16. Brand	37·18	17·53	6·20	15·35	·31	·79	9·05	5·14	2·93	3·62	98·1
17. Do.	37·06	16·78	6·07	15·37	tr.	·57	9·02	5·96	2·86	3·77	97·46
18. Hartzburg ...	36·17	18·09	8·7	13·72	...	·52	11·16	7·59	tr.	2·28	98 23
Schwarzwalder...	33·6	15·	4·99	19·29	...	3·36	11·62	7·53	·51	4·58	100·48
Tydrberger ...	35·5	18·01	9·24	12·11	tr.	3·02	10·86	9·18	1·93		99·85

The averages of these and their ratios are—

		Oxygen.		
Silica	35·9	19·1	19·1	19
Alumina.. ..	17·08	7·96	10·07	10
Ferric Oxide ..	7·04	2·11		
Ferrous Oxide	15·17	3·36	12·34	12 5
Lime	1·65	·47		
Magnesia ..	10·34	4·14		
Potash	7 08	1·2		
Soda	1·64	·42		
Water	2·85	2·75		

Being the same as the Scotch mineral, and standing forward as unimpeachable evidence of its distinctiveness.

In its atomic ratios the mineral stands intermediate between Biotite and lepidomelane, but that which really constitutes the distinctive features of these three micas is the state of oxidation of the iron.

In Biotite the relative proportion of ferrous to ferric oxide is about as 25 to 1.

In Haughtonite (Scotch) it is as 4 to 1.

In Lepidomelane it is as 1 to 9.

There are the following additional chemical distinctions :—

Biotite differs from Haughtonite in containing an amount of magnesia which is twice as great as that of the ferrous oxide; while in Haughtonite the relative proportions of the above protoxides are more than inverted. In the last mineral the iron is chiefly in the ferrous state, in lepidomelane it is chiefly in the ferric.

Altogether there can be no doubt that the mineral is a new one, and I conceive that it is most fitting that it should be named after the gentleman who first analysed the black micas of Ireland, and so established firmly the claim of lepidomelane to be considered a distinct mineral.

It is also happily fitting that it should be called after Dr. Haughton, seeing that it is in Scotland the distinctive mineral of the grey granite, a variety of that rock in the study of which Dr. Haughton has been for long engaged.

The geognostic relations of this mineral are well marked.

In Scotland Biotite occurs in limestones and serpentines, and never in granite.

Haughtonite is never found in the two former rocks, and affects granite more than any other.

We find it chiefly, however, in granitic veins, especially in exfiltration veins. It is the mica special to the mass of that grey granite which covers so large a tract of the county of Aberdeen; muscovite is hardly to be seen in this granite. And the veins of this granite almost invariably show the dark mica in large crystals.

It also occurs in the felspathic bands of gneiss, especially in the highly metamorphosed gneisses.

It is a fact, the bearing of which I have not yet attained to, that oligoclase is its almost invariable associate, and sphene and allanite also frequently accompany it.

I have never yet seen it in distinct crystals, but it has an orthorhombic habit. It frequently occurs in long tortuous crystals—an appearance which I have never seen either Biotite or lepidomelane assume.

Before the blowpipe it fuses with difficulty to a strongly magnetic bead;—the plates of the mineral assume a black of great intensity; Biotite and lepidomelane both pale in colour when heated.

It is more difficultly decomposed by acids than either Biotite or lepidomelane. Chlorhydric acid does not thoroughly effect its decomposition; it gives way to sulphuric however, the silica being left in scales which retain the original lustre of the mineral, or have even acquired a still greater brilliancy.

It does not resist the decomposing power of the atmosphere, as muscovite does; the large amount of ferrous oxide becomes an element of weakness; and some granites crumble from the changes so entailed.

III.—*On some Gold Occurrences.*

By the Rev. J. Clifton Ward, F.G.S., F.R.M.S.

SOME time since Prof. Ruskin kindly sent me a specimen of gold-quartz brought from New Zealand by Mr. H. A. Severn, giving me leave to cut thin slices for the microscope, and asking me to examine the same. The result seems to me of some interest, and Mr. Ruskin has kindly consented to my bringing it before the Mineralogical Society, together with a notice of a strangely beautiful gold occurrence, described by Mr. Severn as disclosed by blasting in one of the New Zealand gold reefs.

Moss-form Gold in Quartz.

The specimen first to be described came from the "Wham Mine," Thames District, Auckland, N. Z. Mr. Severn says "the gold here is largely alloyed with silver, *the two always running together*. The percentage of silver is about 32, the price paid for the gold varying from £2 to £3 per oz. The reefs in some of the mines present remarkable features, bands or layers of auriferous quartz being found of *great value*; thus, in one case 26,000 ozs. were taken out in a few days. Usually both above and below the quartz seam are parallel layers of Antimony and Mundic, the presence of these being always considered a good omen."

The sample of gold-quartz sent me by Prof. Ruskin, was rather more than 2 inches long by $1\frac{1}{2}$ inches to $1\frac{3}{4}$ inches across. Externally there was nothing to indicate the structure disclosed by slicing. The gold appeared finely disseminated in minute points and grains, giving a yellowish tinge to the richer portions.

Several thick slices ($\frac{1}{8}$ in.) were cut, and two very thin ones for microscopic examination. All these revealed a beautiful moss-like crystallization, but feebly represented in Fig. 1 Plate 1. The gold appeared in numerous fine lines at all angles with one another, and seldom more than the $\frac{1}{8}$th of an inch in length, surrounded by shorter gold lines and fine dust, the whole presenting somewhat of a moss-like appearance. Some of the lines were thicker than others, and evidently

represented a more oblique section of the fine gold plates or lamina of which the finest lines were the transverse sections. In some cases indeed the gold laminæ lay in the plane of the section, but seemed in no instances to be bounded by definite lines, rather to be minutely *fringed* out.

The moss-like growth ended in an irregularly rounded outline, tree or rather shrub-like in form, and the quartz above presented a milky appearance (in the $\frac{1}{8}$ in. slices), and was entirely free from gold in any form (see fig. 1). More recent quartz strings seem to have intersected the mass and they also were free from gold.

The thin slices viewed under the microscope gave no further information with regard to the gold, no distinct crystalline forms being observable.

The quartz was carefully examined for liquid cavities, but where the quartz of most quartz veins abounds in them, and they may be readily seen with a good $\frac{1}{2}$-in. or $\frac{1}{4}$-in objective, no single definite liquid cavity was discovered with a magnifying power of 660 diameters. The quartz is much traversed by fine cracks, and under polarized light presents the usual coloured mosaic representing separate crystalline portions. Minute semi-transparent granules are scattered about, and one instance was noticed of a slender transparent needle shooting out from a line of crack. There was nothing special to distinguish the quartz forming the secondary veins from that of the mass.

Tree-form Gold in Quartz Cavern.

The occurrence now to be mentioned was brought to my notice by Mr. Ruskin, and the following particulars are derived from Mr. H. A. Severn. The latter says,—"In the Caledonian Mine, (New Zealand) the gold found amounted to some 12 tons in as many months. A very beautiful specimen was disclosed by a blast; a small cavern was thus brought into view, the interior of which was covered with crystals, but from the centre of its floor grew a golden tree, the lovely and intricate golden branches spreading in all directions, its roots as if growing into the quartz. More singular still were many buds, like pin heads, attached here and there to the golden branches, and these on examination proved to be mundic crystals!"

From further inquiries, I learn from Mr. Ruskin, who saw some of the tree-like gold, that it "was just entangled enough to support itself and no more, trembling with a breath, and not visibly crystalline anywhere to the naked eye." From a pen and ink drawing given me in a letter from Mr. Ruskin, Fig. 2 Plate 1 is taken, to show the shaky

character of the gold thread-stems. Mr. Severn further writes that some of the threads were flat and bent over, that there was no earthy matter whatever in the small cavern, and that the mundic crystals at the ends of the golden threads were *perfect, of decided form, and belonging to the rhombic system.* Gold specks were disseminated in the rock beneath the cavern floor.

I leave the occurrences above-mentioned to the notice of mineralogists. That they are of interest in connection with the origin of gold can hardly be questioned. The laminar gold occurring in Moss-like form, embedded in quartz, free from liquid cavities (unless excessively minute), suggests whether the silica and associated gold could have been deposited in this case by hydro-thermal agency, the water playing a chief part? for if so, how does it happen that the quartz in the immediate neighbourhood of the gold does not show liquid cavities of the same degree of development as in most quartz-*veins?* Is it a usual or *unusual* thing, I would ask, for liquid-cavity bearing quartz to be in juxta-position with gold? Possibly this question yet requires working out, and had I the material to hand I would gladly do my quota towards the investigation.

Although the moss-form gold occurrence may be considered only doubtfully to support the theory of a watery deposition, yet the tree form occurrence seems hardly explicable on any supposition but that of crystallization from an aqueous solution. Its mode of growth within a small cavern or geode, the quartz crystals pointing inwards from all sides of the cavern, and even the gold disseminated in the floor, all seem to point to gold dissolved out of the surrounding rocks or carried up in solution from below, and then slowly crystallizing out from the solution within the cavern. It is impossible to conceive of the hollow being filled with igneously fluid matter from which the gold separated, the igneous mother-liquor wholly disappearing; and very difficult to imagine how the tree could be shot up from the floor of a *dry* cavern, or why it should so grow. On the other hand, on the aqueous theory of deposition, one might suppose that the pyrites heads at the end of the golden fibres represented the last metallic matter contained in solution, the last traces of gold being deposited with the pyrites.

There is so much to support the theory of an igneous deposition of gold (see especially Belt's views in this matter, in his "Nicaragua," pp. 99-102) that the meeting with an occurrence of the tree-form character described, is of special interest. Most likely, the precious metal owes its mode of occurrence to deposition under varied conditions, at one time igneous (fire the chief element), at another hydro-

thermal (water being the conspicuous element). So persistently does nature refuse sometimes to be limited to one hypothetically perfect method of action.

I have brought this matter before the Society with some misgiving, thinking that possibly after all, phenomena such as those described, are well known to mineralogists though I have failed to meet with them described in books, or coming within the experience of many friends of whom I have made enquiry. I trust others may be induced to develope the subject, and follow it into regions beyond my reach.

Postscript.—Since writing the above, my friend Mr. Rutley has shown me a beautiful case (almost unique I believe) of gold upon selenite. Surely this must mean aqueous deposition. Mr. Ruskin has also shown me his beautiful collection of gold occurrences, which might well have a special memoir devoted to them.

IV.—*Additional Note on Penwithite.*

By J. H. Collins, F.G.S.

SINCE my former communication to the Mineralogical Society* I have been endeavouring to obtain a sufficient quantity of the pure mineral therein described to complete my analyses. Plenty of what certain dealers have been selling as Penwithite is obtainable from the rubbish heaps at Wheal Owles, but this is mostly dark-brown—nearly or quite opaque, pitch-like in appearance, and of very variable composition—the silica alone varying from 22 up to 57 p. c., and the sp. gr. often being as high as 3·4.

The true mineral is sometimes attached to masses of such material—it is highly vitreous and transparent, from dark amber to reddish-brown in colour, H. 3·5 and *sp. gr. only* 2·49—a remarkable circumstance considering the large amount of manganous oxide present. Its other properties are as stated in my former note; for convenience I reproduce the particulars here. It is brittle, has a highly conchoidal fracture; heated in matrass gives off water, but is otherwise unchanged; strongly heated in platinum forceps fuses slightly on edges; when digested in coarse powder in hydrochloric acid oxide of manganese is dissolved out and the silica which remains is perfectly colourless.

The mean of three more or less complete and fairly concordant analyses, each, however, performed on less than ½ a gram of the mineral, is as follows :—

Water	21·80 p. c.
Silica	36·40
Oxide of manganese	37·62
Manganic anhydride	tr. †
Oxide of iron	2·52
Uranium peroxide	·30
Copper	tr.
	98·64

Reckoning the iron and uranium as manganese, this answers very closely to the formula $Mn\,Si\,O_3 + 2\,H_2O$, which requires the following proportions :—

MnO	42·5
$Si\,O_2$	35·9
H_2O	21·5
	99·9

* Min. Mag., Vol. II, p. 91.

† The powdered mineral when warmed with solution of potash communicates a green tinge from the formation of manganate.

The chemical composition of this mineral places it near Dana's Neotokite (var. Wittingite)* from Bredvik, which was analysed by Nordenskjold, but the manganese in this latter is in the form of sesquioxide, while in Penwithite it is a protoxide. Moreover, the physical properties are greatly different.

Neotokite is said to be formed by the alteration of Rhodonite, but this does not appear to be the case with Penwithite. On the contrary, it is in some specimens accompanied by entirely unaltered Rhodocrosite, a mineral much more readily altered than Rhodonite: it seems to have been formed like opal by the deposition of a gelatinous siliceous solution in cavities of pre-existing rocks, and several varieties of opal have in fact been found at Wheal Owles, some of them slightly tinged with manganese oxide.

* Dana, Syst. Min., 1875, p. 491 anal 8.

V.—*Note on Christophite from St. Agnes.*

By J. H. Collins, F.G.S.

ABOUT a year since I received from our associate Mr. Alfred Davies, of St. Agnes, a dark-brown mineral which was supposed to consist largely of sulphide of tin. As it differed greatly in appearance from the so-called tin pyrites, I at once felt interested in the supposed new mineral, and commenced an analysis which I have lately been able to complete.

It is generally granular in appearance, dark-brown, translucent very slightly on thin edges, infusible B.B., soluble more or less completely in aqua regia, &c.—in fact its properties differ but little from those of an ordinary dark variety of blende, except that with careful manipulation it yields a bead of tin when treated with reducing agents on charcoal. Most specimens are massive, dark-brown and granular as stated above, but certain small cavities are usually studded with black lustrous crystals, generally minute, but occasionally about 1-3rd of an inch across. The best of these crystals which I have seen exhibits planes of the hemihedral cube and of the positive and negative tetrahedrons.

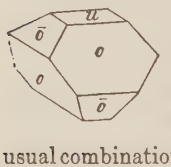
The mean of several analyses of the granular mineral is as follows:—

Zinc	32·0	per cent.
Iron	22·4	,,
Tin	1·2	,,
Sulphur	29·5	,,
Alumina	7·2	,,
Silica	6·8	,,
Copper	trace.	
Lime	trace.	
	99·1	

No alumina or silica can be detected in the crystals by blowpipe tests, but I have not been able to obtain enough of them for a complete analysis. Still there can be no doubt that they are extraneous bodies, and form no part of the mineral as such. Eliminating these constituents we have the following as the probable composition of the mineral:—

Zinc	37·6	Zn S.	56·1
Iron	26·2	Fe S.	41·1
Tin	1·4	Sn S.	1·9
Sulphur	34·7	S.	·8
	99·9		99·9

The tin I think does really form part of the mineral, and probably exists in the state of sulphide, as it is readily soluble in aqua regia, which solvent scarcely attacks native peroxide of tin in the slightest degree. The mineral is therefore very near that variety of blende named *Christophite** by *Breithaupt* from its occurrence at St. Christophe Mine near Johanngeorgenstadt—differing from it only in the larger proportions of sulphide of iron (which is to the sulphide of zinc nearly as 6:5 in molecules) and of tin.



My friend Dr. C. O. Trechmann, of Hartlepool, to whom I shewed the crystals referred to above and figured here, thus describes them :—"The Blende is a very interesting though by no means an unusual development. The crystals are simple (*i.e.* untwinned) and show the usual combination of the two tetrahedrons with the cube; the large development of the 2nd tetrahedron is rather uncommon, and causes the whole crystal to approximate to a holohedral habit. That it is not holohedral is shown by the superficial character of the tetrahedral faces, those belonging to the first, probably the + tetrahedron, are large, bright (polished) and striated parallel to the edges formed by the cubical and 2nd tetrahedral faces, whilst the 2nd, probably the −tetrahedron is small, dull, and uniformly rough. The cube is striated parallel to the 1st tetrahedron.

A slight fracture has exposed the dodecahedral cleavage on the large crystal.

These crystals from St. Agnes are very similar to the beautiful crystals of the same combination from the Binnenthal (dolomite) in Switzerland; though in the latter the striations of the cubical faces generally run in the opposite directions."

* Dana, System of Mineralogy, 1875, p. 49, anal. 14.

IX.—*The History of a Remarkable Gem.—The "Maxwell-Stuart" Topaz.*

By J. H. Collins, F.G.S.

IT is only within the last century that the Cingalese have become the most astute judges upon all matters relating to gems in their uncut or natural state. That this is so is proved by the number of remarkable stones which previously found their way to England, unrecognized as being of any value; amongst them is the stone in question. How it could have been passed over and treated by the merchants as of no value is a mystery, unless its great size contradicted the probability of its being a gem. Such, however, was the case; it having been sent to England mixed with the ordinary pieces of inferior Rubies and Sapphires used by watchmakers. It was sold for a mere nominal sum, as a piece of Quartz, or Crystal, and passed into a private collection of minerals, the owner of which regarded it also as a specimen of Quartz. At his decease it was sold by public auction with his minerals, by Messrs. Stevens, the natural history auctioneers, of Covent Garden. Again, remarkable to relate, not any of the mineralogists or dealers in gems recognized it, and it was purchased with other stones by a private gentleman, Mr. Herbert Maxwell-Stuart, of Scarthingwell Hall, Yorkshire, for the sum of £3 10s.

This gentleman, having collected gems for many years, and being an authority on uncut gems, immediately discovered its true nature, and for many years it formed the centre of attraction in his cabinet, and was shown to the gentry of the county as being the largest gem in the world. At last Mr. Maxwell Stuart decided to have it cut and polished, and travelled from York to Edinburgh, to consult the lapidaries there on the subject. However, a great disappointment awaited him. He was informed, after examination, that it would be impossible to cut such a large stone (measuring about 4½ inches square) of that material, its hardness being so great. It was also stated that even if cut, it would not be pure, two or three large flaws to all appearances running nearly through the stone. Some London lapidaries said the same, and the gem lay for some time untouched, until Mr. Maxwell-Stuart showed it to Mr. Bryce-Wright, of Great Russell Street, London, who, upon examination, not only pronounced the cutting perfectly feasible, but believed it could be accomplished without leaving a single flaw. He further offered to purchase it for a large sum if he was satisfied on re-examining it with the aid of a powerful artificial light. This was allowed,

and Mr. Maxwell-Stuart, perhaps doubting the feasibility of its being cut, and especially without a flaw, was tempted to part with the stone.

On securing the gem, Mr. Bryce-Wright had several moulds taken of it, from which were cast in gelatine eight or ten perfect models upon which to operate. The gem itself was then examined with the greatest care under a lime-light, being previously dipped in a preparation of turpentine to render it more transparent, and the exact position, width and length of the flaws carefully noted. These were then measured and imitations of them made *in wood* of the precise length and width; they were then inserted in the models of gelatine in exactly the same positions as the flaws were in the original. Thus several imitations of the real gem were made, containing pieces of wood in place of the flaws. These were then cut out of the gelatine in several directions, care being taken to cut perfectly straight, or in a manner that a lapidary's wheel could act, leaving several irregular blocks of gelatine representing the gem *without* the flaws. It was then easy to choose the form of cutting, and to determine upon which model the true gem was to be cut.

The stone was then placed upon the wheel and cut precisely to the shape of the chosen model, thus effacing all the flaws. Here victory seemed complete, as the polishing was all that had to be done, when unfortunately, what is termed a feather appeared, perhaps through the strain in cutting, in the position in which it was determined to place the table. This seemed at first sight an insurmountable difficulty, until Mr. William Lunan, the lapidary employed proposed to remove the "feather" by reversing the original plan, and placing the table where it had been arranged the culet should be. The feather which was horizontal was thus removed in the cutting and polishing of the large plane. The gem was cut as a brilliant on a diamond wheel, without further mishap. The polishing was the next step, the wheel for this purpose was of an unusual size, and made of bell-metal. The rapidity with which this had to be driven to polish such large facets on such a hard stone was very great, and rendered it impossible to continue the work for more than a minute or so at a time; the stone being so hot, as also the cement forming the handle to which it was attached, that it could not be held in the hand.

Plate III is an outline shewing the original size of the gem with the positions of the principal flaws. The final result of the cutting is seen in figs. 1 and 2, plate IV.

The operations of cutting and polishing commenced on the 12th May, and ended on the 12th June, having thus occupied 28 days of incessant labour.

That it is the largest cut precious stone known (exclusive of the Cairngorum, which is only Quartz, and much softer) there can be little doubt. It is pure white, and possesses a brilliancy hardly, if ever, equalled in this gem. Its weight is 1,475·9 grains, or 368 carats 3·9 grains; its specific gravity is 3·5685. As to its value, this is simply hypothetical, there being no standard on which to reckon the value of such an exceptionally fine stone.

X.—*List of Japanese Minerals, with Notes on Species which are believed to be New.*

By John Milne, Yedo, Japan.

DURING the last three years I have been engaged in collecting and cataloguing the minerals of Japan. The following is a list of the species with which I am acquainted. The arrangement is according to the classification given by Dana in his System of Mineralogy.

1. Native Gold
* 2. Native Silver
* 3. Native Copper
* 4. Meteorite (?) two, one from the Bonin Islands, the other from Idzu
5. Amalgam
6. Arsenic ?
7. NATIVE SULPHUR
8. Graphite
9. Realgar
10. Orpiment
11. Antimonite
12. Molybdenite
13. Argentite
14. GALENITE
15. Bornite
16. Sphalerite
17. Cinnabar
*18. Pyrrhotite
19. PYRITE
20. CHALCOPYRITE
21. Mispickel
*22. Tetrahedrite
23. Halite
24. Fluorite ?
25. Hematite
26. Clay Iron Stone
27. MAGNETITE
*28. Chromite
29. Cassiterite
*30. Rutile
31. Pyrolusite
32. Limonite
*33. Psilomelane
34. QUARTZ (rock crystal, amethyst, false topaz, catseye, chalcedony, agate, jasper, flint
35. Opal
36. Wollastonite ?
37. Augite
*38. Spodumene ?
*39. Rhodonite
40. Hornblende, asbestus, &c.
41. Olivine
42. Garnet
43. Epidote
44. Hisingerite ?
45. Vermiculite ?
46. Muscovite
47. Orthoclase—glassy felspar, obsidian, pumice, pitchstone, &c.
48. Tourmaline
49. Topaz
50. Chrysocolla
*51. Analcime
52. Talc (Steatite, &c.)
*53. Meerschaum
54. SERPENTINE

55. Kaolinite
56. Chlorite
*57. Vivianite?
58. Turquois?
59. Nitre
60. Barite
*61. Anhydrite
62. Gypsum
*63. Chalcanthite
64. Melanterite
65. Alum
66. Alunite?
67. CALCITE (Chalk, &c.)
*68. Dolomite
*69. Aragonite
70. Diallogite
*71. Cerusite
72. Malachite
*73. Azurite
74. Cobalt Ore
75. AMBER
COAL (anthracite, bituminous, lignite, peat, &c.)
*76. Asphalt
*77. PETROLEUM.

Those marked with an asterisk are rare, and I have not yet been able to obtain specimens of them. Doubtful species are followed by a note of interrogation. Names printed in large type indicate common species. Of these latter I have had opportunity of examining many hundreds of specimens. The list has been chiefly compiled from the following sources.

1st. From information gained whilst travelling in various parts of the country (Nipon, Shikoku, Yezo, and the Kuriles.)

2nd. From the extensive collection of minerals placed in my charge by the Mining Department.

3rd. From the large collection of Minerals exhibited at the National Exhibition of Japan, held in Yedo, 1877.

4th. From the collection of minerals exhibited at the exhibition of Kioto, in 1878.

In looking over the above list of minerals the reader cannot fail to observe the absence of many important groups of minerals. Thus, in a country like Japan where the prevailing rocks are of volcanic origin, one would naturally expect to meet with some of the Zeolites. Up to the present I have not been able to meet with any of them, and if they exist at all they are probably extremely rare.

Amongst the metallic minerals a paucity of species will also be observed, a fact which is the more remarkable when we consider the vast number of mines which are being worked. An explanation for this might be that the miners only paid attention to those minerals which were of commercial value. From what I have seen the more probable explanation is that the mines do not yield any variety of ore.

Specimens Nos. 24, 36, 44, 45 are probably new varieties of old species, if not altogether new.

No. 45. (Vermiculite)? Occurs in short six-sided prisms usually about 6^{mm} long and 3 to 4^{mm} broad. These are made up of a number of laminæ united together at right angles to the length of the prism. The surfaces of these prisms are too irregular to admit of any measurements being made upon them. In order to obtain measurements I took laminæ obtained by cleavage, and after covering them with ink obtained an impression upon paper. The profiles thus obtained were extended by carefully ruled lines, the angles between which gave the angles of the prism.

In three cases the opposite angles of the hexagon were as follows :—

1st ... $\left\{\begin{matrix}127^\circ\ 30' \\ 123^\circ\ 30'\end{matrix}\right\}$ mean $125^\circ\ 30'$ $\left\{\begin{matrix}114^\circ \\ 119^\circ\end{matrix}\right\}$ mean $115^\circ\ 30'$ $\left\{\begin{matrix}118^\circ \\ 116^\circ\end{matrix}\right\}$ mean $117^\circ\ 15'$

2nd ... $\left\{\begin{matrix}126^\circ \\ 130^\circ\end{matrix}\right\}$ mean 128° $\left\{\begin{matrix}116^\circ \\ 115^\circ\ 30'\end{matrix}\right\}$ mean $115^\circ\ 45'$ $\left\{\begin{matrix}120^\circ \\ 111^\circ\end{matrix}\right\}$ mean $115^\circ\ 30'$

3rd ... $\left\{\begin{matrix}124^\circ \\ 121^\circ\ 30'\end{matrix}\right\}$ mean $127^\circ\ 45'$ $\left\{\begin{matrix}119^\circ \\ 118^\circ\ 30'\end{matrix}\right\}$ mean $118^\circ\ 45'$ $\left\{\begin{matrix}116^\circ \\ 119^\circ\ 30'\end{matrix}\right\}$ mean 118°

From these rough measurements it would apparently seem that this mineral is rhombic, the prisms shewing a combination of a basal pinacoid, a prism, and a brachy or macro-pinacoid.

Although I made several sections of this mineral I could only obtain a brownish-red translucent leaf, which gave no distinguishing optical characteristics. From a partial analysis furnished me by Mr. J. H. Collins, it loses 6·41 p.c. of its weight on ignition. In this respect, in some of its blowpipe reactions and in some of its physical appearances, it resembles a Biotite.

It cleaves parallel to the basal pinacoid.

The cleavage surfaces thus obtained have a blackish-green to brown colour, and a brilliant but slightly pearly lustre. The streak is yellowish-brown. Externally the faces of the crystals are covered with an adherent film of ochreous matter.

H. about 1·5; G. about 2·7; fusibility above 5. With nitric and sulphuric acid it dissolves slowly, leaving a residue of silica. With hydrochloric acid it dissolves more quickly, giving a solution changing from brown to green and a residue of silica. When strongly heated either on charcoal or by means of the blowpipe it rapidly expands longitudinally to 6 or even 12 times its original length, at the same time twisting and writhing very like a Pharoah's Serpent. After having been thus heated it breaks up easily into metallic-looking golden scales.

It occurs near Tsurasee on the Kofu side of the Sasango Pass, in the beds of streams running down from granite hills, where it is collected by the inhabitants and sold for medicine, being first burnt before being administered.

From the odd way in which it writhes upon charcoal it is used by the inhabitants of the neighbourhood as a source of amusement, and it is often shewn to passing travellers, (especially on wet afternoons when time hangs heavily) as a local wonder.

No. 24. Fluorite, var. Chlorophane. This occurs massive. It is of a light-green colour and has a vitreous lustre.

Hardness *about* 4.

Specific gravity in one specimen 3·16, in another 3·13.

With hydrochloric acid or nitric acid when cold there was no change, but with sulphuric acid there was an evolution of gas. When heated with this latter acid it gave much white froth.

On heated platinum it shews a most striking phosphorescence not unlike burning sulphur.

It cleaves readily parallel to the faces of an octahedron, the angles as measured by a hand goniometer being 108° and 71°.

It occurs at the silver mine of Ikuno in Tajima associated with a white mica (Gilbertite ?) quartz and iron pyrites.

It is also found at Hakui in Noto, and at Inabegori in Ise. Some from this latter locality is white and some slightly purplish.

No. 44. Hisingerite ? This is an amorphous black mineral with an external black lustre. Owing to numerous fissures by which it is penetrated, it is very friable.

Streak, greyish-green. Hardness, 2·5—3. Specific gravity, 3·1. Fusibility about 5. With hydrochloric acid it gives a green solution and gas is disengaged slowly. By heat the solution becomes orange-yellow, and with the exception of a flocculent precipitate all is dissolved.

I am indebted to J. H. Collins, Esq., F.G.S., for an analysis of this mineral. He obtained from the mass—silica, 31·35 ; protoxide of iron, 41·76 ; peroxides of iron and alumina, very little ; magnesia, 5·08 ; and water, 7·24 ; but small selected fragments gave,—

Silica	24·5
Protoxide of iron	61·0
Peroxide of iron	3·2
Water	9·8
	98·5

with traces of manganous oxide, lime, magnesia, alumina and potash. Its physical characters so much resemble those of Hisingerite that I propose to refer it to this species, notwithstanding its apparent difference in chemi-

cal composition, which may be due to the difficulty in separating it sufficiently pure.

It occurs at the iron mine of Nakaosaka, where it is seen running in irregular veins through deposits of magnetite.

No. 36. Wollastonite? This is a massive pure white mineral with an internal fibrous structure, the fibres radiating somewhat irregularly from various centres.

Specific gravity, 2·82. Is infusible. With hydro-chloric acid a slightly yellowish-green solution is obtained, but with other acids it is unchanged.

From an analysis made by Mr. Tekichi, furnished to me by Dr. Divers, its composition is as follows:—

Calcium Oxide	48·07
Silica	51·63
Iron Oxide	a trace.
Alumina	a slight trace.
Magnesia	absent.
Water	absent.
	99·70

The formula is therefore $Ca\,O$, $Si\,O_2$.

XI—*Measurements of Angles of Basaltic Columns in the Giants' Causeway, County of Antrim; made in* 1877,

By Rev. J. H. Jellett, B.D., Fellow of Trinity College, Dublin.*

(A) TETRAGONS. (Sum=360°)

I.	a	90°	IV.	a	115°
	b	91		b	86
	c	87		c	88
	d	91		d	69
		359°			358°
II.	a	79°	V.	a	84°
	b	83		b	87
	c	118		c	88
	d	92		d	96
		372°			355°
III.	a	74°	VI.	a	90°
	b	100		b	80
	c	93		c	82
	d	90		d	102
		357°			354°

(B) PENTAGONS (Sum=540°)

I.	a	103°	III.	a	117°
	b	115		b	109
	c	96		c	113
	d	110		d	83
	e	115		e	103
		539°			525°
II.	a	108°	IV.	a	115°
	b	109		b	122
	c	106		c	124
	d	113		d	74
	e	99		e	105
		535°			540°

* Communicated by Rev. Samuel Haughton, M.D.

V. a ———103°
b ———102
c ———118
d ———113
e ——— 97
533°

VI. a ———105°
b ———127
c ———128
d ——— 83
e ——— 91
534°

(C) HEXAGONS (Sum=720°)

I. a ———142°
b ———137
c ——— 86
d ———119
e ———130
f ———109
723°

II. a ———106°
b ———116
c ———130
d ———110
e ———130
f ———124
716°

III. a ———115°
b ———129
c ———123
d ———127
e ———121
f ———164
719°

(D) HEPTAGONS (Sum=900°)

I. a ———107°
b ———115
c ———139
d ———139
e ———140
f ———128
g ———139
907°

II. a ———126°
b ———138
c ———129
d ———115
e ———130
f ———120
g ———125
883°

III. a ———133°
b ———129
c ———108
d ———113
e ———124
f ———143
g ———135
885°

IV. a ———120°
b ———130
c ———142
d ———122
e ———137
f ———131
g ———115
897°

V.	a	140°	VI.	a	127°
	b	125		b	118
	c	143		c	136
	d	143		d	131
	e	128		e	122
	f	117		f	118
	g	119		g	140
		915°			892°

(E) OCTAGONS (Sum=1080°)

I.	a	138°	III.	a	138°
	b	130		b	129
	c	137		c	144
	d	144		d	135
	e	130		e	146
	f	120		f	138
	g	143		g	132
	h	140		h	125
		1082°			1087°
II.	a	166°	IV.	a	127°
	b	143		b	140
	c	138		c	144
	d	120		d	133
	e	117		e	131
	f	139		f	140
	g	140		g	140
	h	127		h	115
		1090°			1078°

With regard to the relative frequency of the several kinds of columns, Professor O'Reilly, of the Royal College of Science for Ireland, makes the two following estimates:*—

1°. Out of 200 columns observed—

Tetragons	3·54 per cent.
Pentagons	24·75
Hexagons	50·50
Heptagons	19·19
Octagons	2·02
	100·00

2°. Professor O'Reilly took another and perfectly independent measure by laying down a line of 50^m long, in another part of the Causeway,

* In a letter addressed to Dr. Haughton, 18th June, 1878.

and then counting the number and nature of the Polygons which the line crossed. The result was as follows :—

Tetragons ..	3	1·98 per cent.
Pentagons ..	47	30·73
Hexagons ..	72	47·00
Heptagons ..	30	19·63
Octagons ..	1	0·66
	153	100·00

Reviews and Notices.

On the remarkable new Mineral locality in Fairfield County, Connecticut, &c., by Geo. J. Brush and E. S. Dana.

UNDER this title the authors describe* a remarkable assemblage of seven well-defined mineral phosphates, four of which, viz., Eosphorite, Dickinsonite, Triploidite, and Lithiophilite, have already been adverted to in the pages of the Mineralogical Magazine, vol. II, p. 100. The other three are named Reddingtonite, Fairfieldite, and Fillowite respectively.

The chief characters of all the seven are given in a tabular form below for easy reference.

	H	G	APPEARANCE.	FUS.
Eosphorite ..	5	3·132—3·145,	often resembles green elæolite	4
Triploidite ..	4·5-5	3·697 ..	yellowish to reddish-brown	1
Dickinsonite ..	3·5-4	3·338 ..	various shades of green ..	1
Lithiophilite ..	4·	3·424 ..	salmon-coloured	1-1·5
Reddingtonite	3-3·5	3·102 ..	yellowish-white	2
Fairfieldite ..	3·5	3·15 ..	white to pale straw-yellow	4·5
Fillowite ..	4·5	3·41—3·45	yellowish to reddish-brown	1·5
Altered *Lithiophilite*	3-4	3·26—3·40	black to purple	

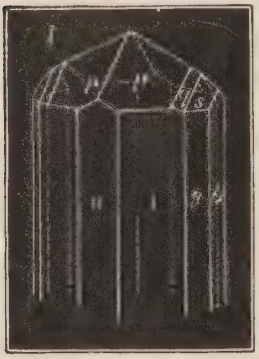
Lithiophilite is anhydrous, the others are hydrous; all are soluble in HCl or HNO_3; all are transparent to translucent.

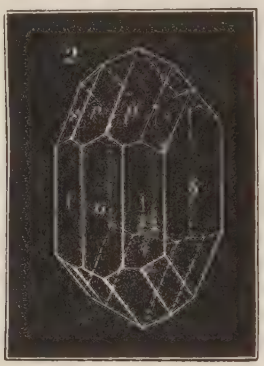
The formulæ of the minerals is given below.

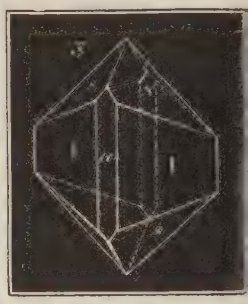
Eosphorite ..	$R_2Al_2P_2O_{10}$, $4H_2O$	or	$Al_2P_2O_8+2H_2Mn(Fe)O_2+2H_2O$
Triploidite ..	$R_4P_2O_9$, H_2O	or	$Mn_3(Fe_3)P_2O_8+Mn(Fe)H_2O$
Dickinsonite	$4(R_3P_2O_8)$, $3H_2O$	or	$4(MnFeCaNa_2)\ 3P_2O_8+3H_2O$
Lithiophilite	$LiMnPO_4$	or	$Li_3PO_4+Mn_3P_2O_8$
Reddingtonite	$R_3P_2O_8$, $3H_2O$	or	$Mn_3(Fe_3)P_2O_8+3H_2O$
Fairfieldite ..	$R_3P_2O_8$, $2H_2O$	or	$Ca_3(Mn_3Fe_3)P_2O_8+2H_2O$
Fillowite ..	$3R_3P_2O_8$, H_2O	or	$3(MnFeCaNa_2)_3P_2O_8$; H_2O

* Am. Journ. Sci., July and August, 1878, and May 1879.

Eosphorite is Rhombic in crystallization, the form being related to Childrenite as shown in the accompanying figures, where fig. 1 represents one of the crystals, while fig. 2 is a crystal of Childrenite, from Hebron, Maine; and fig. 3 a crystal of Childrenite, from Tavistock; the three crystals being drawn in similar positions.

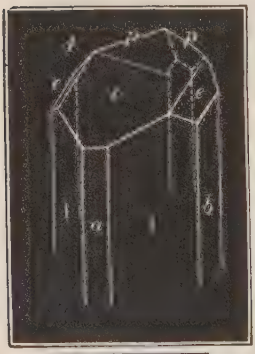






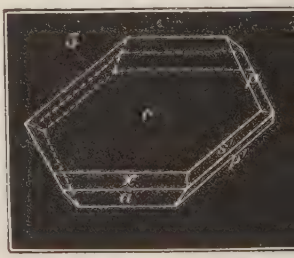
In order to bring the crystals of Childrenite into this position, the clinodome (n of Miller) is made the unit prism. The crystals are distinctly trichroic. The axial colours are as follows:—

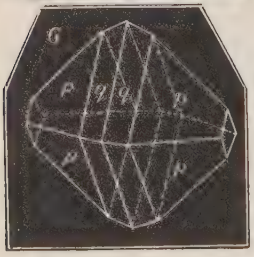
α (b Miller) yellowish.
β (a Miller) deep pink.
γ (c Miller) faint pink.



Triploidite is oblique and homeomorphous, with Wagnerite; the form of the crystals is given in fig. 4.

Dickinsonite is also oblique, but the crystals have a marked rhombohedral (hexagonal) aspect, as seen in fig. 5. It is distinctly dichroic.



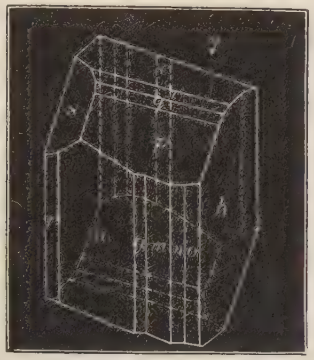


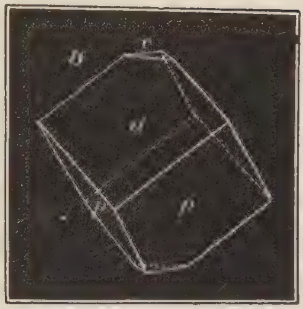
Reddingtonite is *Rhombic*, and nearly related in form to Scorodite and Strengite (this Magazine Vol. II, p. 99). The axial ratios of the three species are as follows:

	c *(vert)*	b̄	ă
Reddingtonite....	1·0930	1·1524	1·
Scorodite (*Vom Rath.*)	1·1020	1·1530	1·
Strengite *(Nies)*....	1·1224	1·1855	1·

Fig. 6 represents a crystal of Reddingtonite.

Fairfieldite is Anorthic, as shewn in fig. 7.





Fillowite is oblique, but with distinctly rhombohedral aspect. as shewn in fig. 8.

Stibianite.—(E. Goldsmith, *Proc. Acad. Nat. Sci., Philadelphia*, 1878, *p.* 154.)—This mineral is from Victoria, Australia. It is massive, somewhat porous,reddish-yellow, but not uniformly; dull; H=5; G=3·66 BB on with soda C, yields antimony reactions, gives no colour to a bead of micro. In matrass yields water, soluble in HCl, Aqua Regia, KHO and SHAm; the solubility in KHO indicates absence of antimonious acid, while a solution of sulphate of copper shews presence of antimonic acid.

Analysis shews—94·79 p.c. of antimonic anhydride, and 5·21 of water, yielding the formula $Sb_2O_5H_2O$.

Staffelite.—(*Ibid p.* 157).—This occurs on the well-known Amazon stone of Pike's Peak, Colorado.

Huntilite.—(*Wurtz. Engineer and Min. Journ., N. Y., Jan.* 25, 1879). Occurs in two varieties. The most abundant variety is amorphous—often porous, dark slate-grey or almost black; dull. The crystalline variety is cleavable in one direction, and of a lighter slate-colour. H about 2·5, streak bronze-coloured, sub-malleable. Probable formula $As Ag_3$. Occurs at the Silver Islet Mine, Lake Superior. Named after Dr. Sterry Hunt.

Randite.—(G. A. Koenig, *Proc. Acad. Nat. Sci., Phil.*, 1878, 408.) Earthy probably crystalline; H=2·3. Probable formula $Ca_5 U_2 C_6 O_{20} + 3H_2O$, which would place it near Liebigite. Named after Dr. D. Rand, of Philadelphia.

ANIMIKITE.—(*Ibid.*)—Occurs alone or with Huntilite; G=9·45; white or grayish-white; fracture fine granular; conchoidal. Analysis gives

Sb.	11·18
As.	·35
S.	1·49
Hg.	·99
Ag.	77·58
Co.	2·10
Ni.	1·90
Fe.	1·68
Zn.	·30
Gangue.	1·68
Total	99 25

Found at Silver Islet Mine, Lake Superior. Named from an Indian word meaning *Thunder*—whence Thunder Bay.

HANNAYITE.—(VOM RATH. BALL, *Soc, Min., France*, 79, 1879.)—Triclinic. Basal cleavage perfect, less perfect parallel to two prismatic planes. G=1·893. Mean of two analyses gave

P_2O_5	45·70
MgO	18·90
NH_3	8·09
H_2O	28·20
	100·89

21·08 p.c. of water lost between 100° and 120° C. Found at the Skipton Caves, Victoria.

NEWBERYITE.—(*Ibid.*)—Rhombic. Cleavage brachydiagonal, perfect; basal, imperfect; analysis gave

P_2O_5	41·25
MgO (diff) ..	23·02
H_2O	35·73
	100·00

Probable formula $Mg_2P_2O_7 + 7Aq$. Found at Skipton Caves, Victoria, with Hannayite.

Obituary.

W. R. Williams was born 7th January, 1828. He was in practice as a civil and mining engineer for about 30 years in the Dolgelly district, that is including Festiniog, Corris, &c., slate quarrying districts; and frequently called away to more distant places, both in North and South Wales to report and advise in slate quarrying and mining. He was largely connected with gold mining in North Wales, and one of the first engaged in it. His practice also included civil engineering, surveying and valuing, to a very considerable extent, as well as architecture and estate agency in a general country practice. He was for some years prior to his death chairman of the School Board in the parish of Dolgelly, and generally took an active part in all the public affairs appertaining to this part of the country. He was elected a Fellow of the Geological Society of London in 1865. During the whole 30 years of his practice he associated himself with most of the improvements in the Dolgelly district. He died at Vron-Arran, on the 11th January, 1879.

William Vivian was born in the parish of Kea, Cornwall, 2nd June, 1817. He entered the service of Messrs. J. Taylor and Sons, in 1853. Was manager of Parys Mines, Anglesea, 1860. Was appointed manager of Mwyndy Iron Ore Mines, Glamorganshire, on the 1st August, 1863, and died at the mines on the 18th April, 1879.

His kindly disposition endeared him to all who knew him, and he generally managed to impart a portion of his enthusiasm for the beauties of microscopic crystals to every visitor, whether a mineralogist or not, by exhibiting to him under the two inch power of the microscope, the numerous crystal-lined caves and tunnels so abundantly to be seen in vein-stones, glass, and furnace products. Although in failing health for several years, he was taken away rather suddenly at last. He suffered from congestion of the lungs for about a week, but became much worse on the night of the 17th April, 1879, and died at 6.30 on the morning of the 18th.

The following is a list of his scientific papers:—

Observations on the mining district of Sonora, Tuolumne Co., California. (1852) Trans. R.G.S.C. VII, 216-19.

Observations on the gold fields of the Pacific coast, and their prboable extent. (1858) *ib.* VII, 327-31.

Constitution and structure of slate. (1858) *ib.* 339-42.

Essay on the more perfect opening and ventilation of mines. Rep. R.C.P. Soc. (1855) p. XVII.

Observations on the crystalline forms of native metals. *Ib.* (1859) pp. 46-48.

On the arborescent native copper in the Llandudno Mine, near Great Orme's head, North Wales. Journ. Geol. Soc. XV, 109-10 (1858).

Practical mining, &c. Letters in H. C. Salmon's Mining and Smelting Mag. Vol. I, (1862).

Microscopic observations on the structure of metals. Rep. Brit. Assoc. (1862), Pt. II, p. 34.

On the cellular structure of metallic iron. Proc. of S. Wales Inst. of Engineers, V. 129, 179-81, (1866).

On the application of the microscope to the study of mineralogy and metallurgy. Trans. Cardiff Naturalist Soc., 1868-69, p. 13.

Water—Its conditions of solid, fluid, and vapour. *Ib.* 1871.

On the use of the microscope in mineralogy, geology, and metallurgy. Western Chronicle of Science, I, 199-204, (1872).

Miners' Diseases. *Ib.* I, 205-206.

Notes on the oxides of iron enclosed in Quartz, at Mwyudy, Glamorganshire. Min. Mag., Nos. 1 and 4, (1877).

CONTENTS

VOL. III.—No. 13 contains

	PAGE.
Excerpt Minutes of Council	iii
HALL. Contributions towards a History of British Meteorites	1
HEDDLE. Geognosy and Mineralogy of Scotland	18
HEDDLE. Preliminary Notice of supposed New Scottish Minerals ...	57
AITKIN. Occurrence and Localities of Abriachanite...	69
HEDDLE. On Haughtonite, a New Mica	72
WARD. On some Gold occurrences	85
COLLINS. Additional Note on Penwithite	89
COLLINS. On Christophite from St. Agnes	91
COLLINS. On the "Maxwell-Stuart" Topaz	93
MILNE. On Japanese Minerals	96
JELLETT. Measurements of angles of Basaltic Columns in Giant's Causeway	101
REVIEWS AND NOTICES	105
OBITUARY (Williams and Vivian)	109

ORIGINALLY PRINTED IN GREAT BRITAIN BY MESSRS. LAKE AND LAKE, TRURO. REPRINTED OFFSET LITHO BY BIDDLES LTD., THE CITY PRESS, GUILDFORD, SURREY